27es JNI 2026 PARIS
et la région Île-de-France Palais des Congrès
Journées Nationales d'infectiologie
du jeudi 18 juin au samedi 20 juin 2026
Journée Nationale de Formation des Paramédicaux en Infectiologie
Vendredi 19 juin 2026

Particules fines … mais lourd fardeau !

Lien entre pollution aérienne et infections respiratoires

Dr Alexandre Gaudet
Médecine Intensive Réanimation
Université de Lille – CHU de Lille

Université de Lille
CHU LILLE
CIIL CENTER FOR INFECTION & IMMUNITY OF LILLE
Institut Pasteur de Lille
Group for the Assessment of ICU-related Impacts of Air Pollution
G A Ï A

Déclaration de liens d'intérêt avec les industriels de santé en rapport avec le thème de la présentation (loi du 04/03/2002) :

L'orateur ne souhaite pas répondre ☐

- **Intervenant** : GAUDET Alexandre
- **Titre** : Particules fines mais lourd fardeau : lien entre pollution aérienne et infections respiratoires

- Consultant ou membre d'un conseil scientifique ☐ OUI ☑ NON
- Conférencier ou auteur/rédacteur rémunéré d'articles ou documents ☐ OUI ☑ NON
- Prise en charge de frais de voyage, d'hébergement ou d'inscription à des congrès ou autres manifestations ☑ OUI ☐ NON
  Shionogi, MSD, 4P Pharma
- Investigateur principal d'une recherche ou d'une étude clinique ☑ OUI ☐ NON
  Pfizer, AIRINSPACE

4000 – 12000

4000 – 12000

décès, "Great Smog" de Londres

Bell, Davis & Fletcher. Environ Health Perspect. 2004. Traffic in smog at night. Grant, Henry. ©London Museum. ¬© Henry Grant Collection/Museum of London

5 – 9 décembre 1952

Tableaux de grippes graves

4000 – 12000

décès, "Great Smog" de Londres

Bell, Davis & Fletcher. Environ Health Perspect. 2004. Traffic in smog at night. Grant, Henry. ©London Museum. ¬© Henry Grant Collection/Museum of London

5 – 9 décembre 1952

Tableaux de grippes graves

4000 – 12000

décès, "Great Smog" de Londres

Usines, centrales charbon, bus Diesel

Vague de froid, anticyclone

Bell, Davis & Fletcher. Environ Health Perspect. 2004. Traffic in smog at night. Grant, Henry. ©London Museum. ¬© Henry Grant Collection/Museum of London

De quoi parle-t-on ?

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Dioxyde de soufre
SO_2

Dioxyde d'azote
NO_2

Particules < 2.5 µm
$PM_{2.5}$

Particules < 10 µm
PM_{10}

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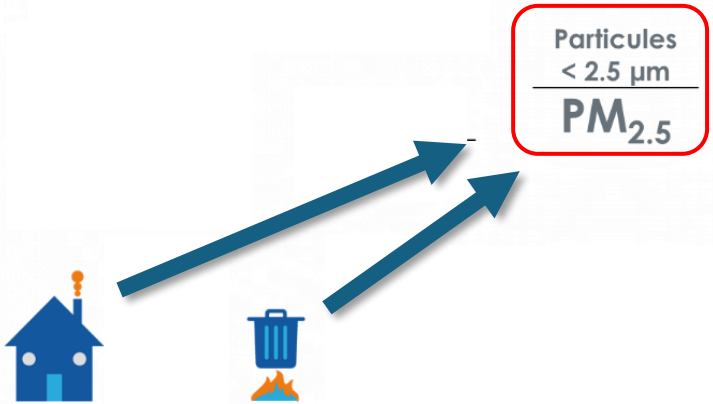

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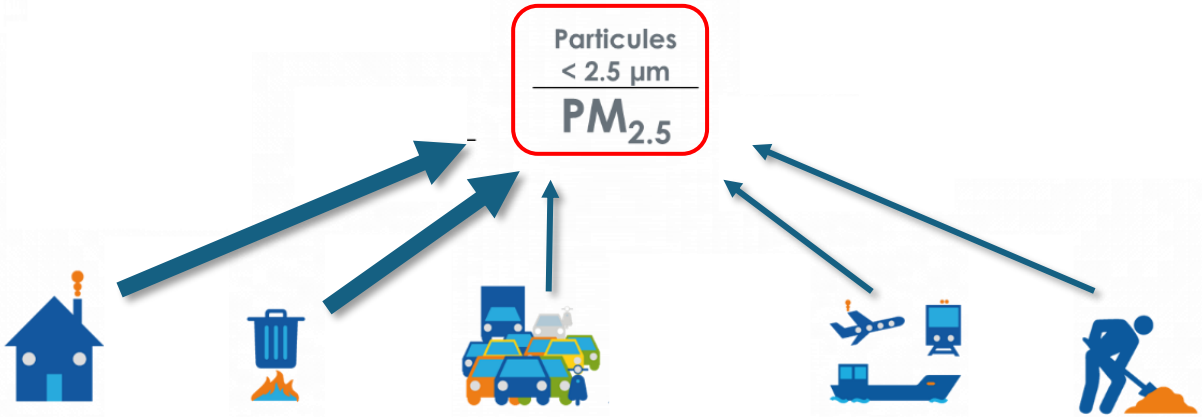

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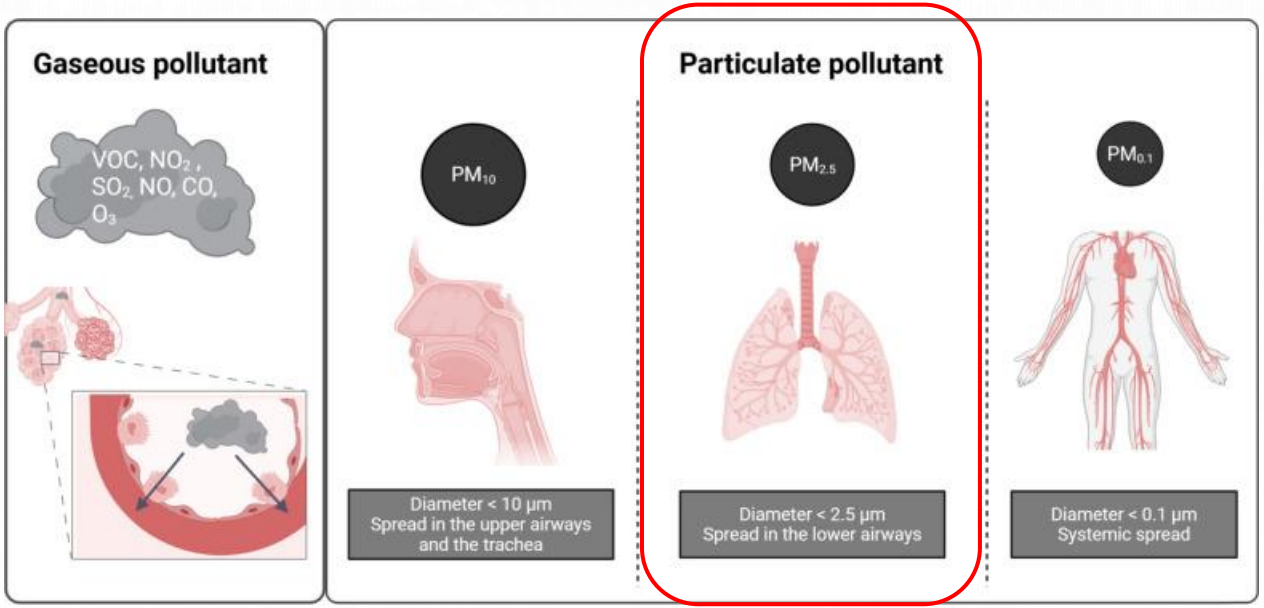
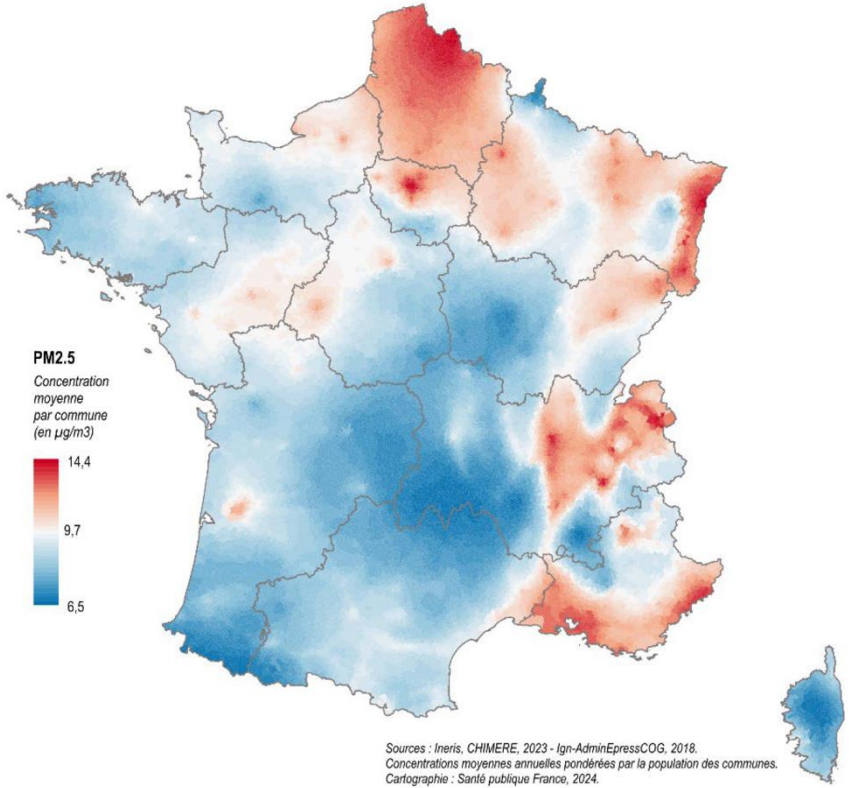


Gaudet, et al. *Intensive Care Med Exp.* 2026

De quoi parle-t-on ?

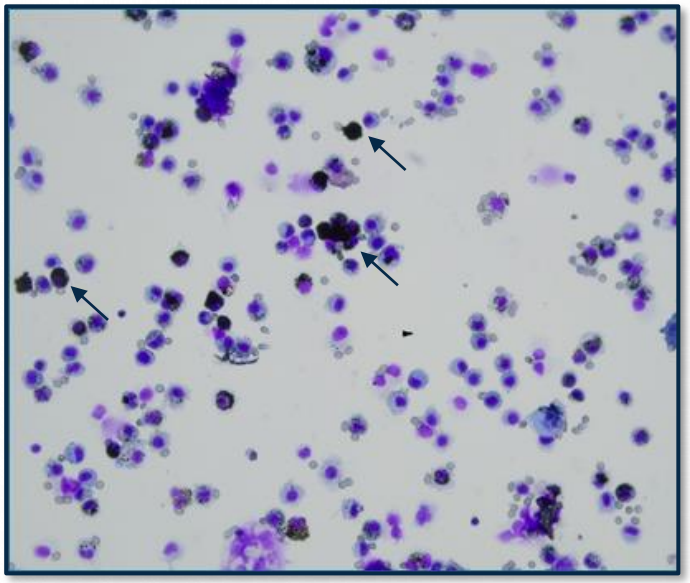


Santé Publique France - ESTIMATION DE LA MORBIDITÉ ATTRIBUABLE À L'EXPOSITION À LONG TERME À LA POLLUTION DE L'AIR AMBIANT ET DE SES IMPACTS ÉCONOMIQUES EN FRANCE HEXAGONALE, 2016-2019 ENVIRONNEMENTJANVIER 2025 Volume 1 : Évaluation quantitative d'impact sur la santé (EQIS-PA)


Question de susceptibilité

Une empreinte persistante

Souris
Particules Diesel
Exposition 3 semaines **– Wash out 3 semaines**

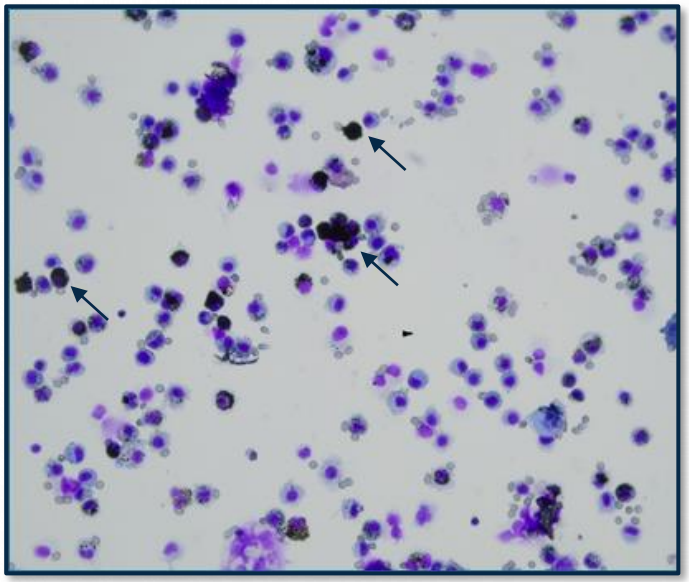


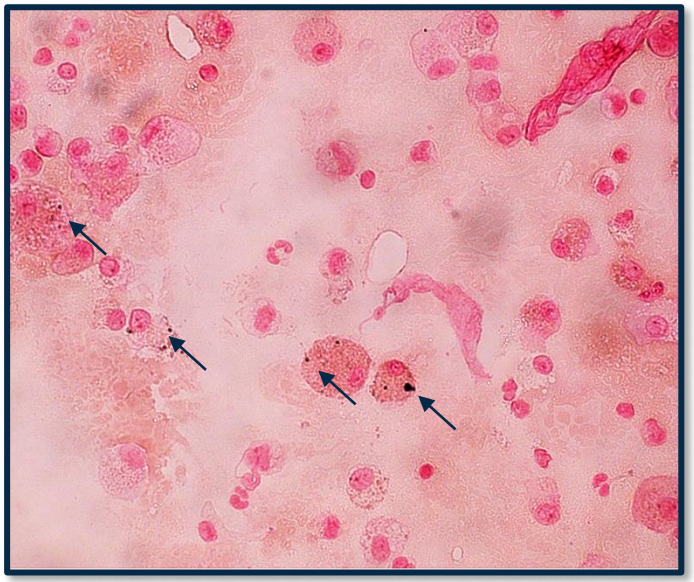
Données A. Gaudet, C. Lacombe - GAÏA

Une empreinte persistante

Souris
Particules Diesel
Exposition 3 semaines **– Wash out 3 semaines**

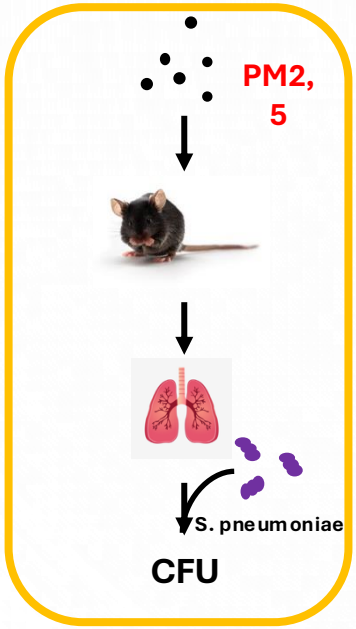
Patient de réanimation
Exposition non-connue
LBA **> 48h de VM invasive**

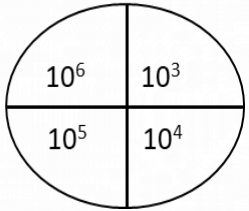




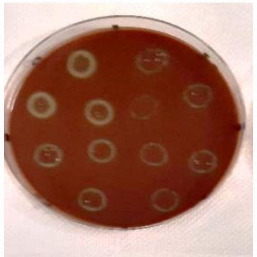
Données A. Gaudet, C. Lacombe - GAÏA

Un inoculum incontrôlé

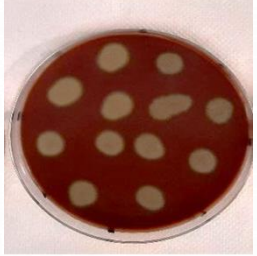


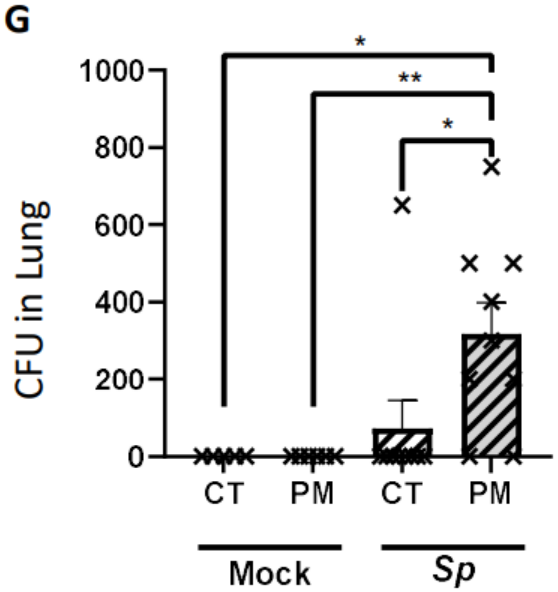


Souris Controles



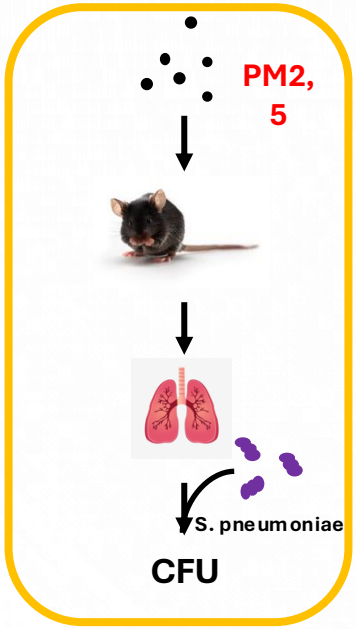
Souris PM 3 in

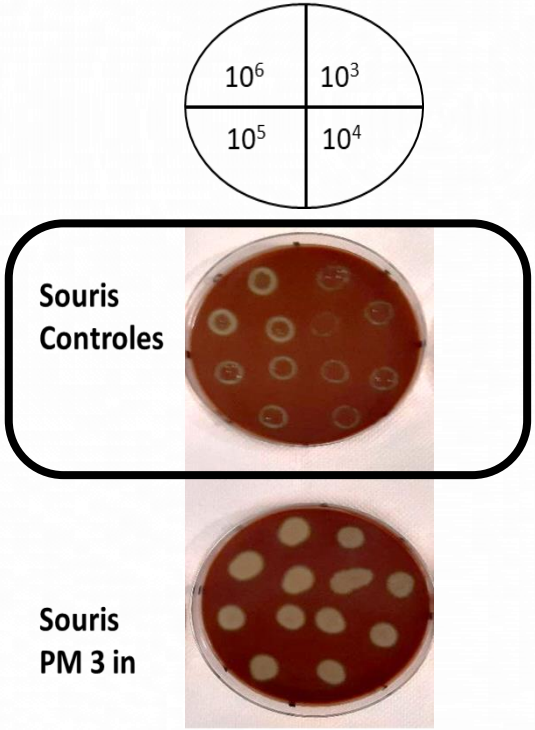


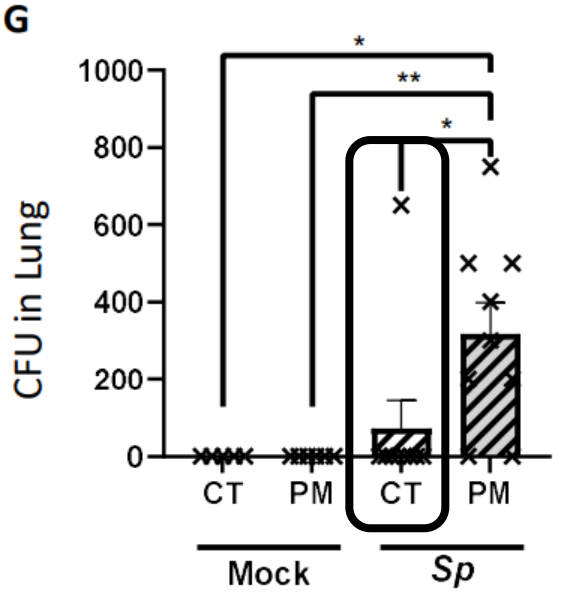


Driencourt, et al. Under review.

Un inoculum incontrôlé







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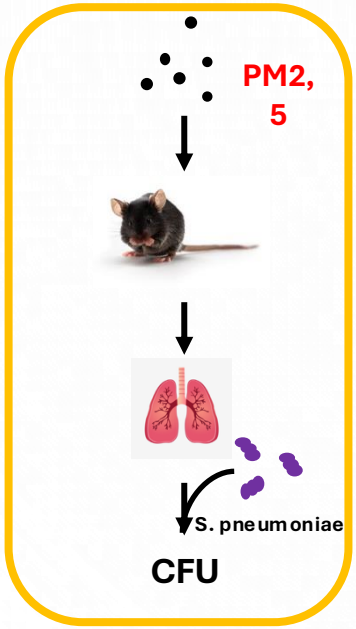
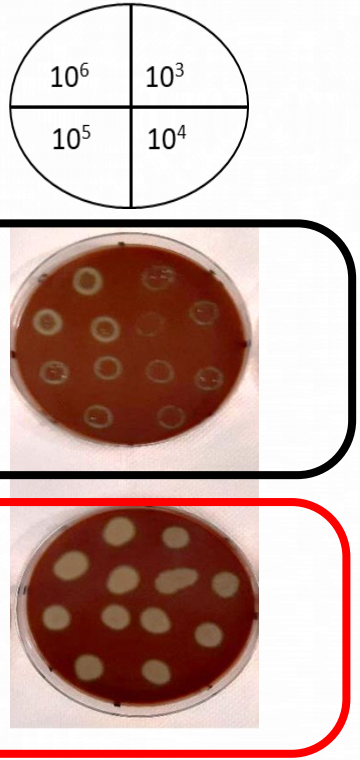
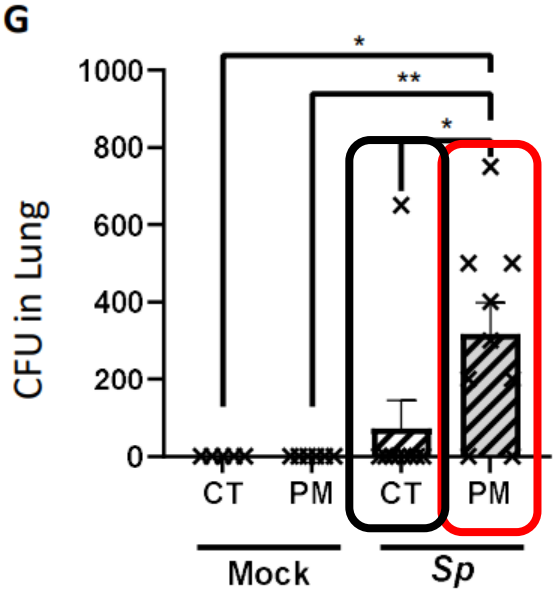
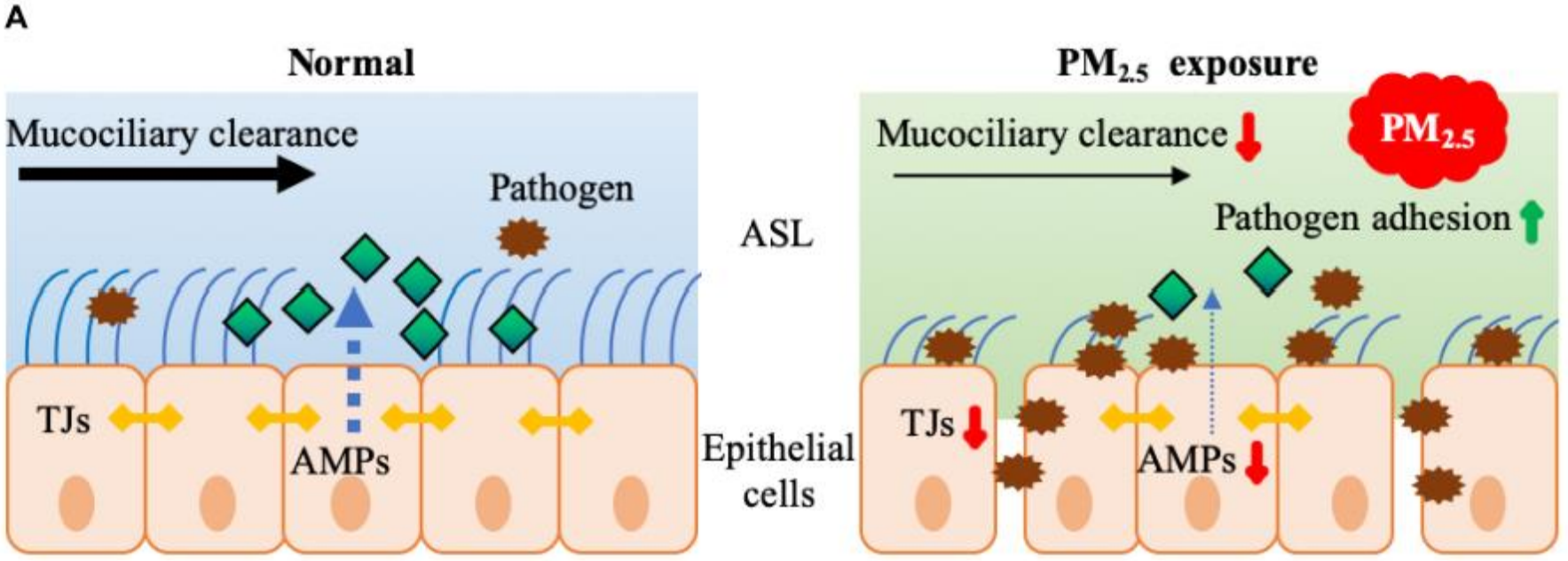






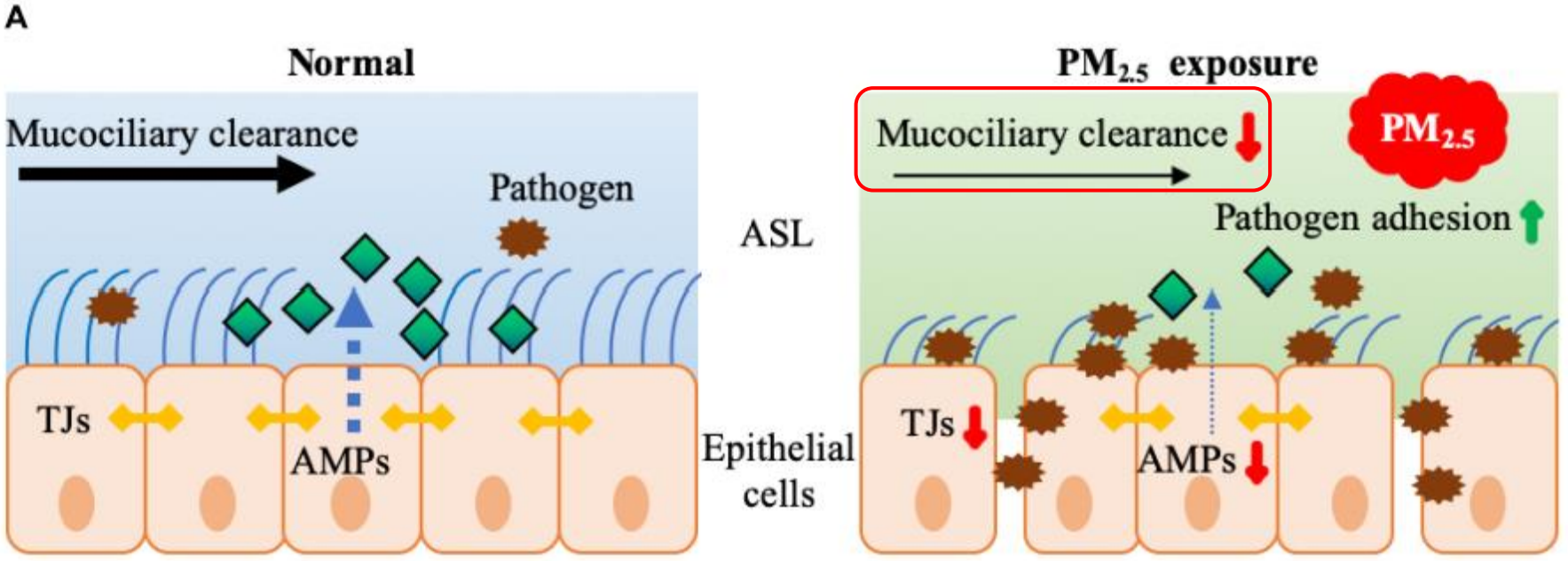
Driencourt, et al. Under review.

Altération de la barrière épithéliale



Yang, et al. Front. Cell Dev. Biol. 2020.

Altération de la barrière épithéliale



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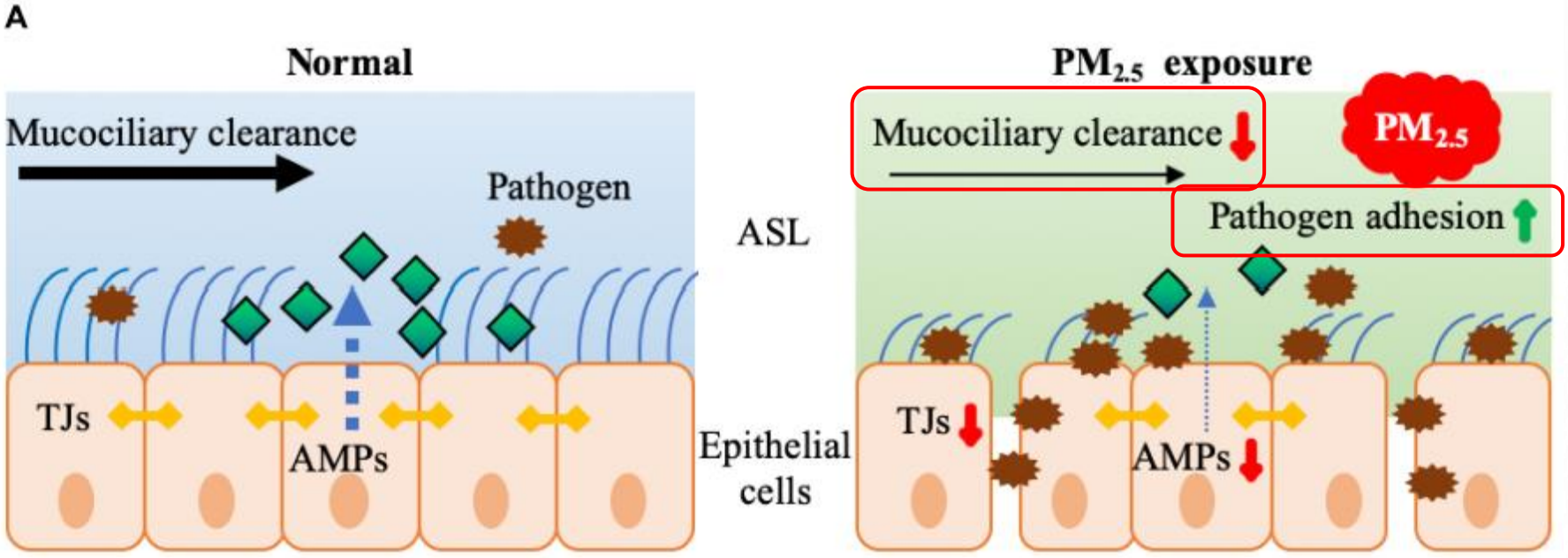

Yang, et al. Front. Cell Dev. Biol. 2020.

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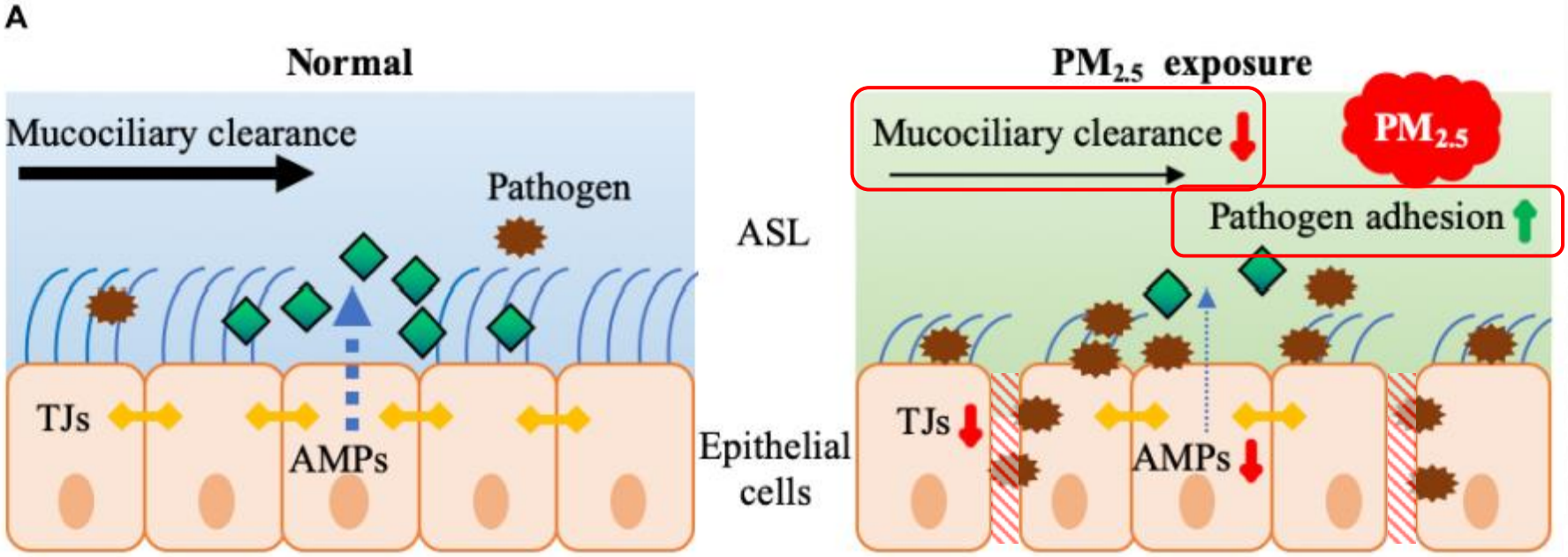

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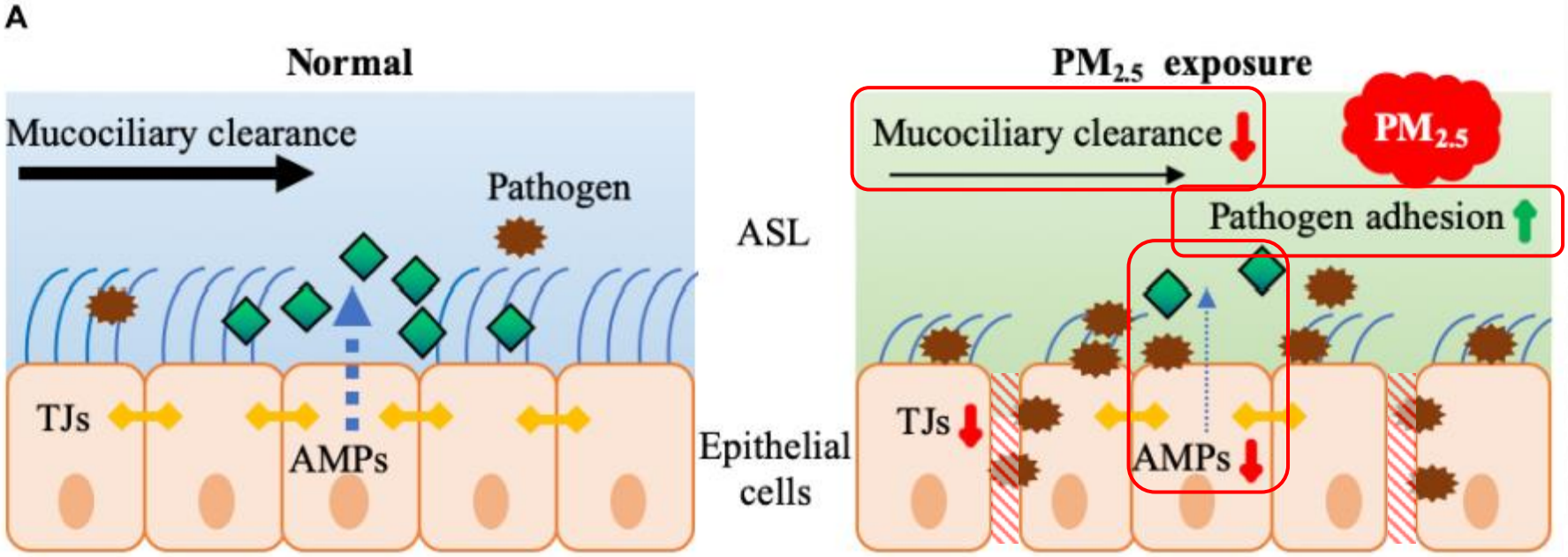


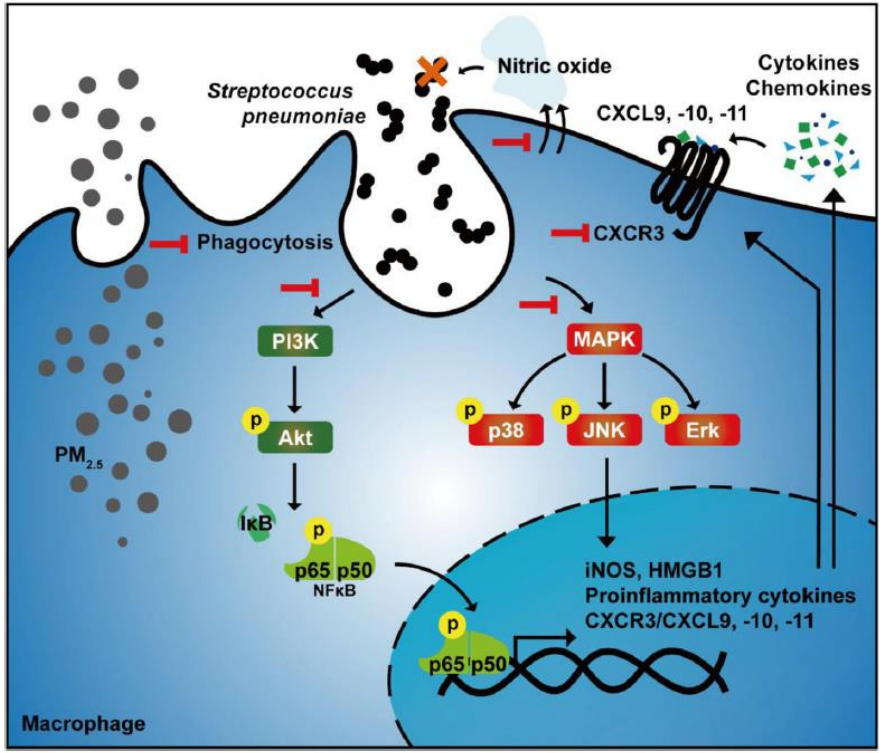
Yang, et al. Front. Cell Dev. Biol. 2020.

Altération de la réponse macrophagique

Souris

Exposition $PM_{2.5}$

Pneumonie à pneumocoque



Chen, et al. Part Fiber Toxicol. 2020.

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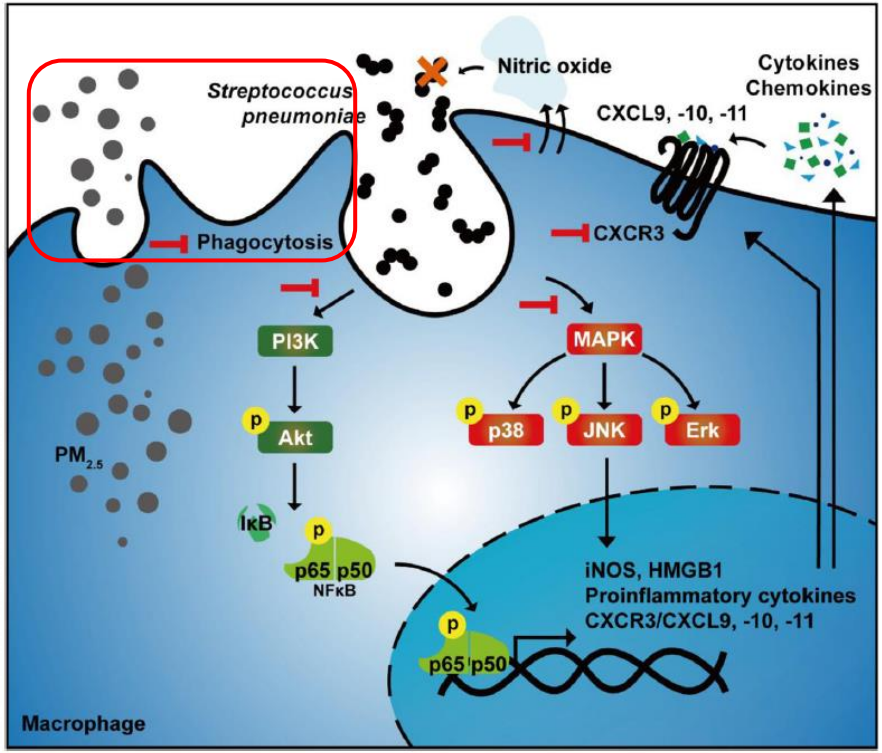

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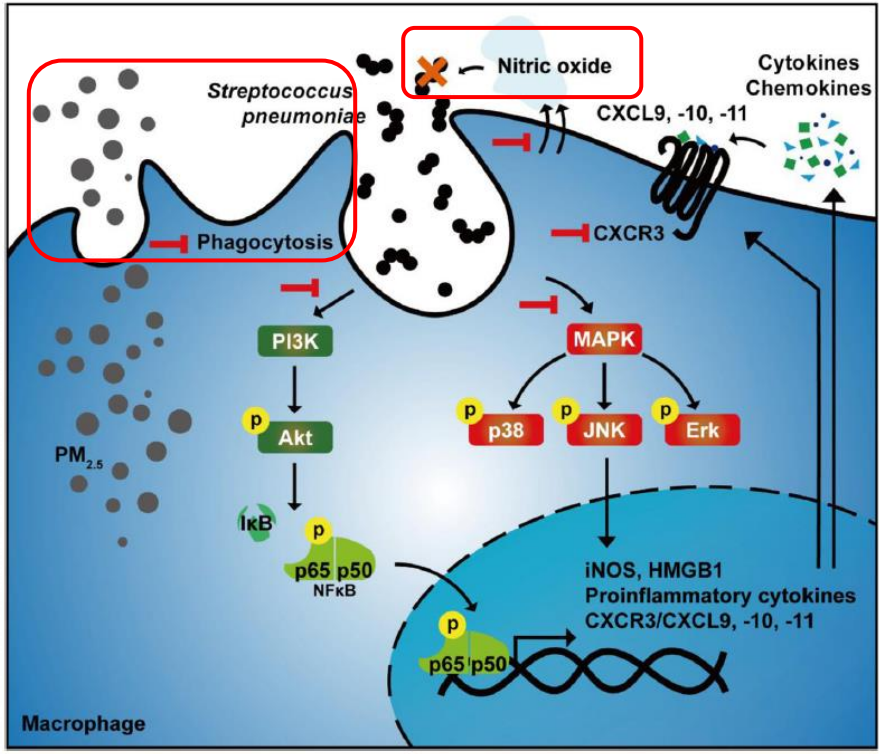

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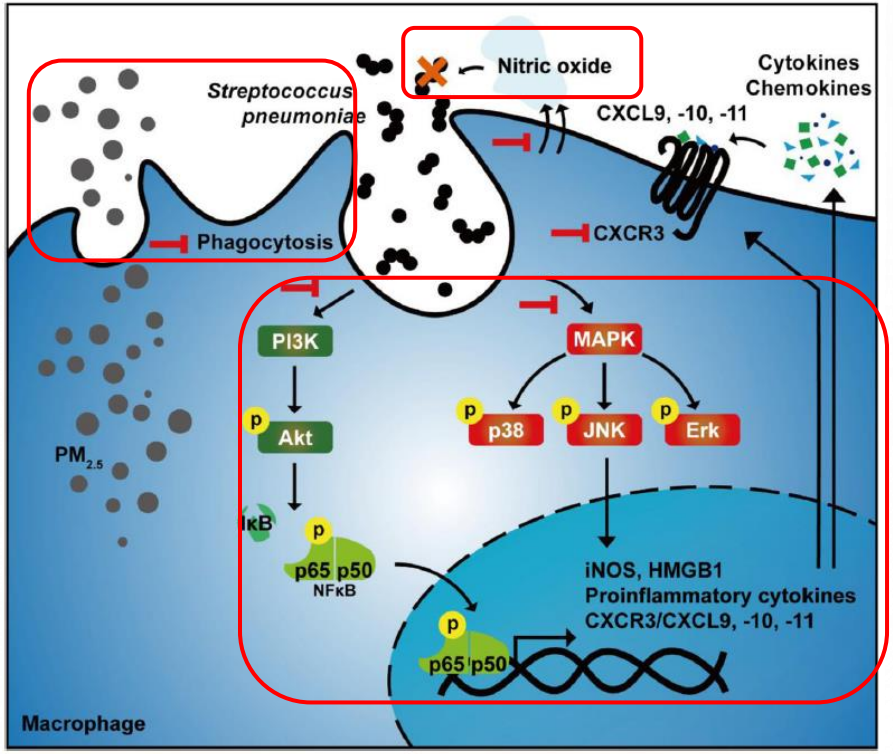

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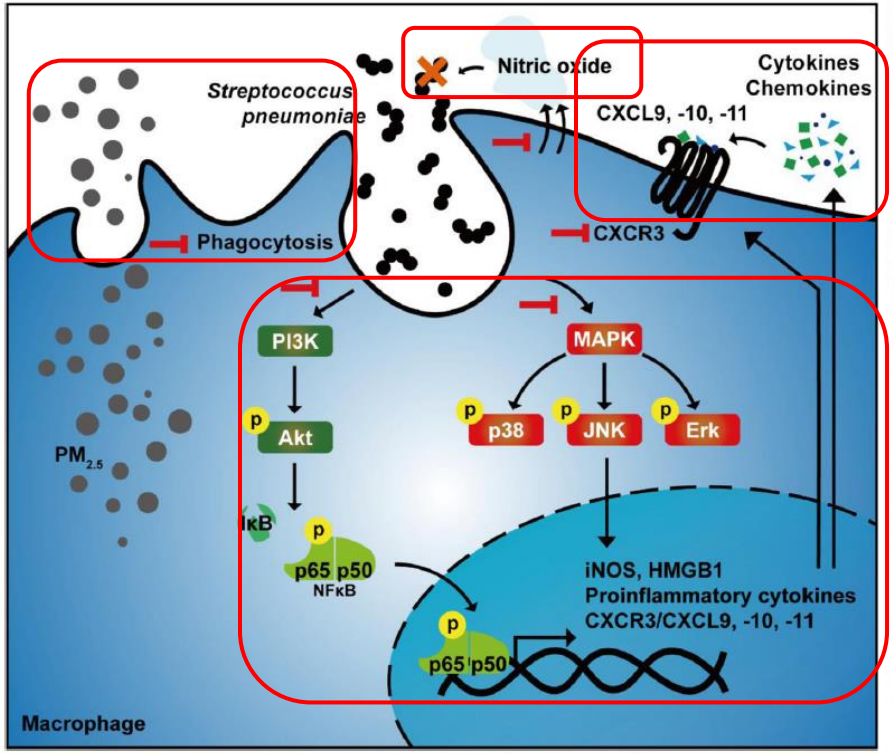
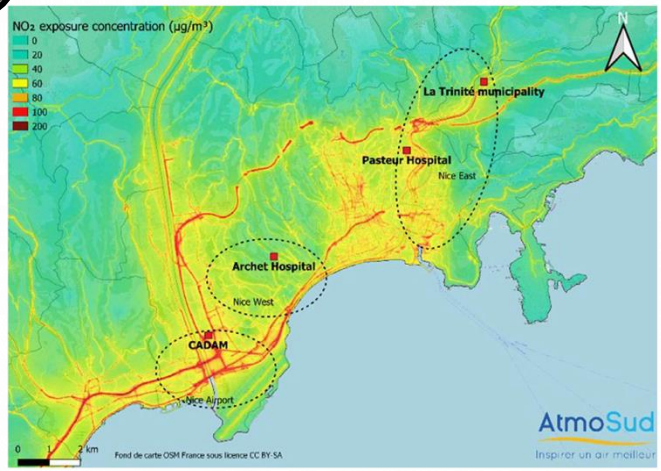
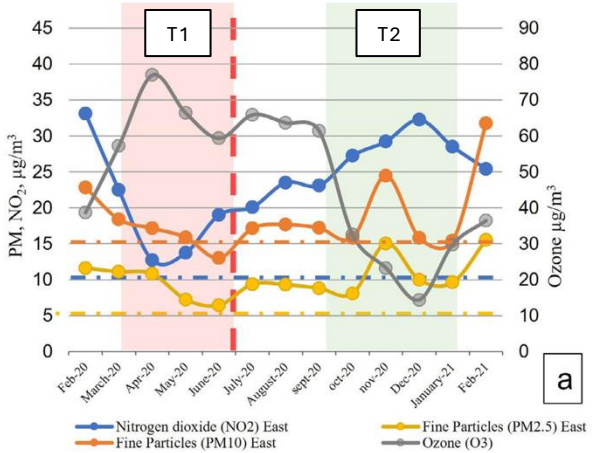


Chen, et al. Part Fiber Toxicol. 2020.

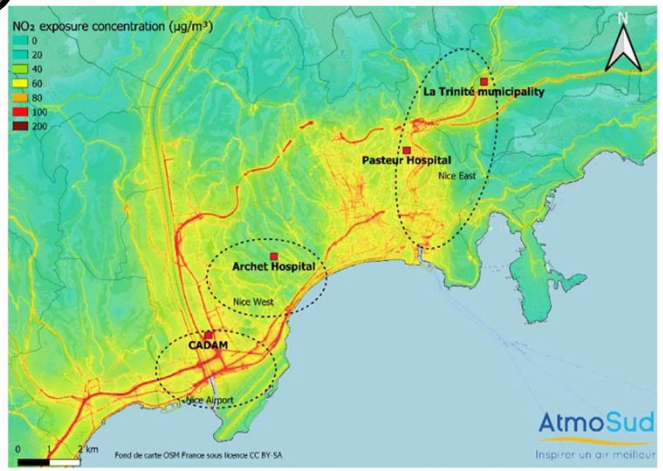
Altération de la réponse lymphocytaire

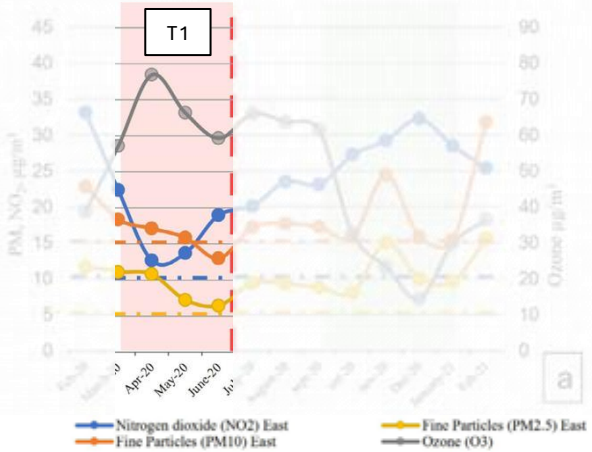




Allouche, et al. eBioMedicine. 2022.

Altération de la réponse lymphocytaire





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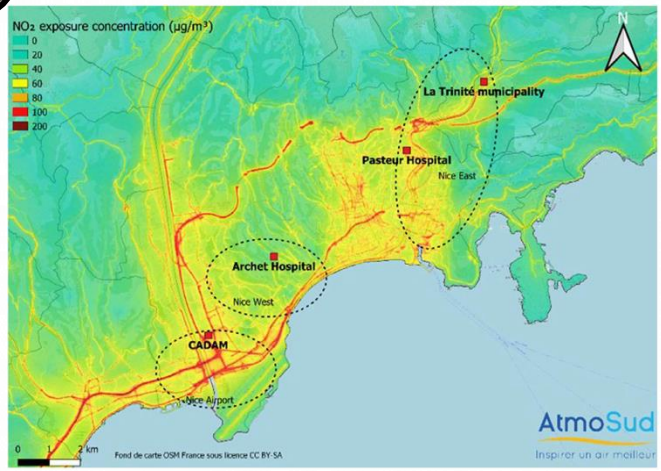

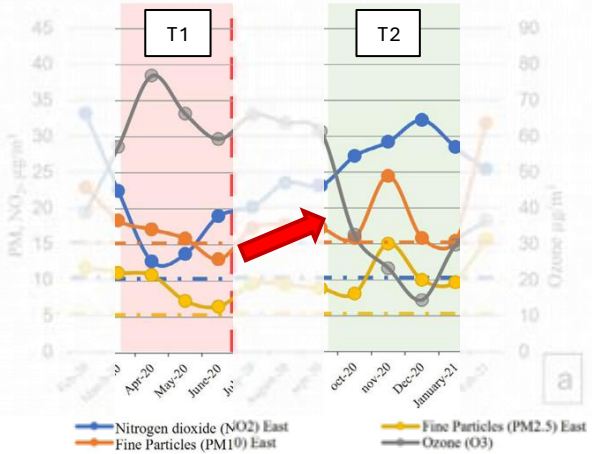

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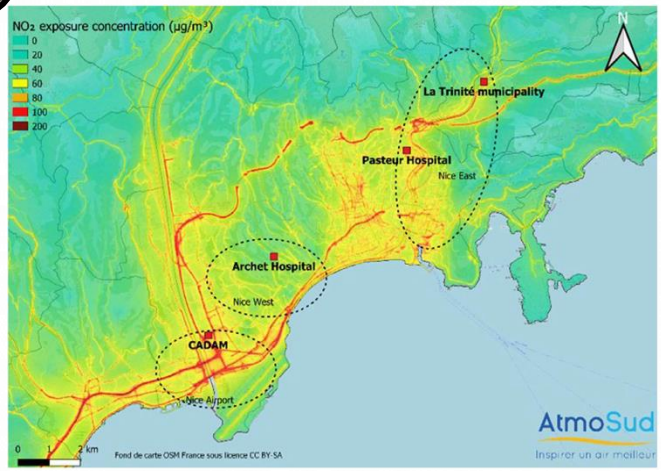
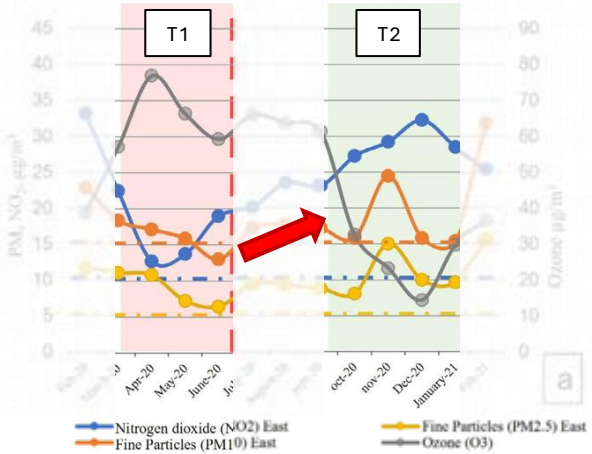
Altération de la réponse lymphocytaire



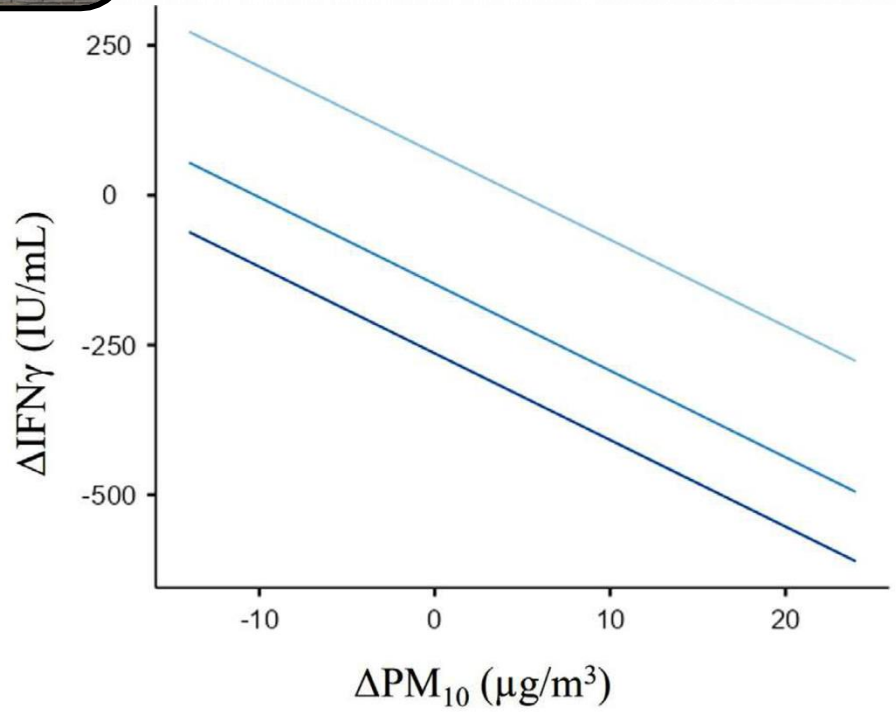


Ex vivo lymphocyte stimulation (anti-CD3 / TLR7-8)

Correlation Δ pollutant / Δ IFN?

Allouche, et al. eBioMedicine. 2022.

Altération de la réponse lymphocytaire



Déficit de réponse IFNγ

Allouche, et al. eBioMedicine. 2022.

Un vecteur pour les pathogènes

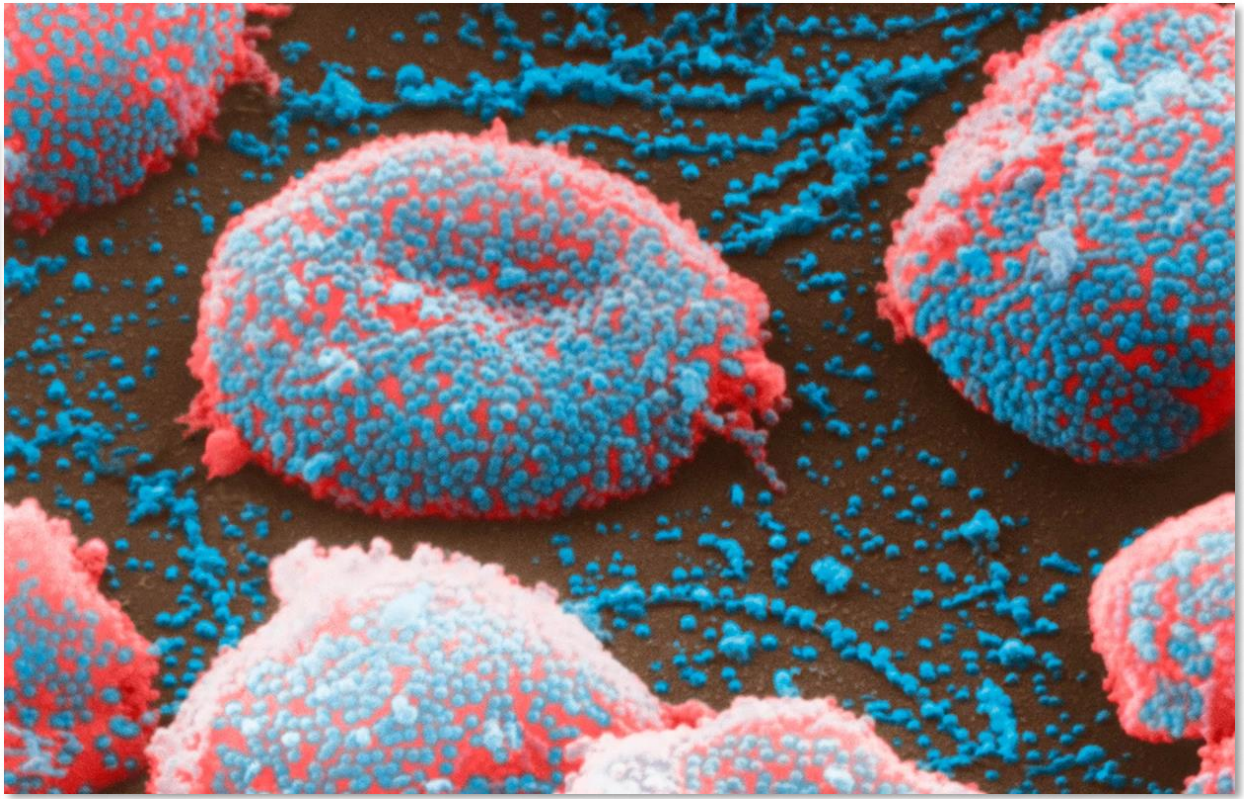
Flu virus hitches a ride with haze particles deep into the lung

Fine particulate pollution help the virus to enter cells, which might explain why influenza is worse when air quality is bad.

Souris

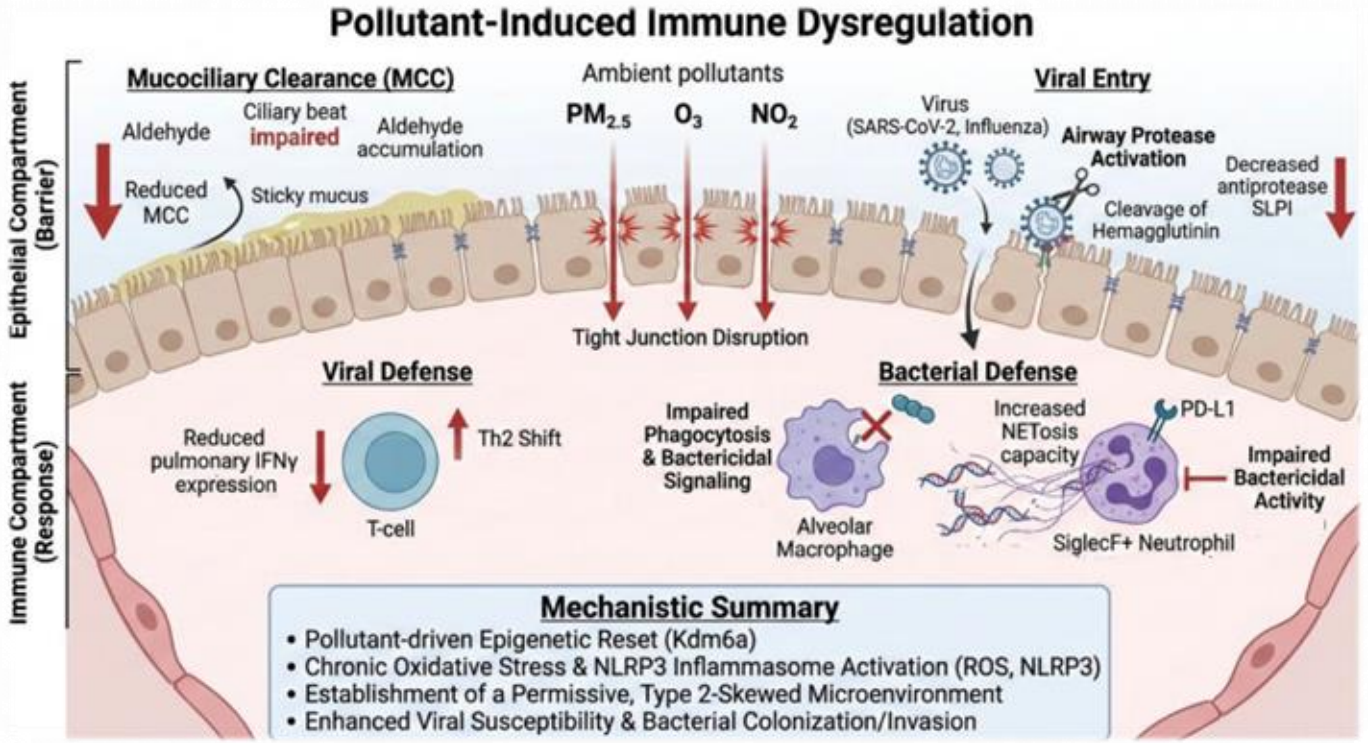
Exposition $PM_{2.5}$

Virus de la grippe



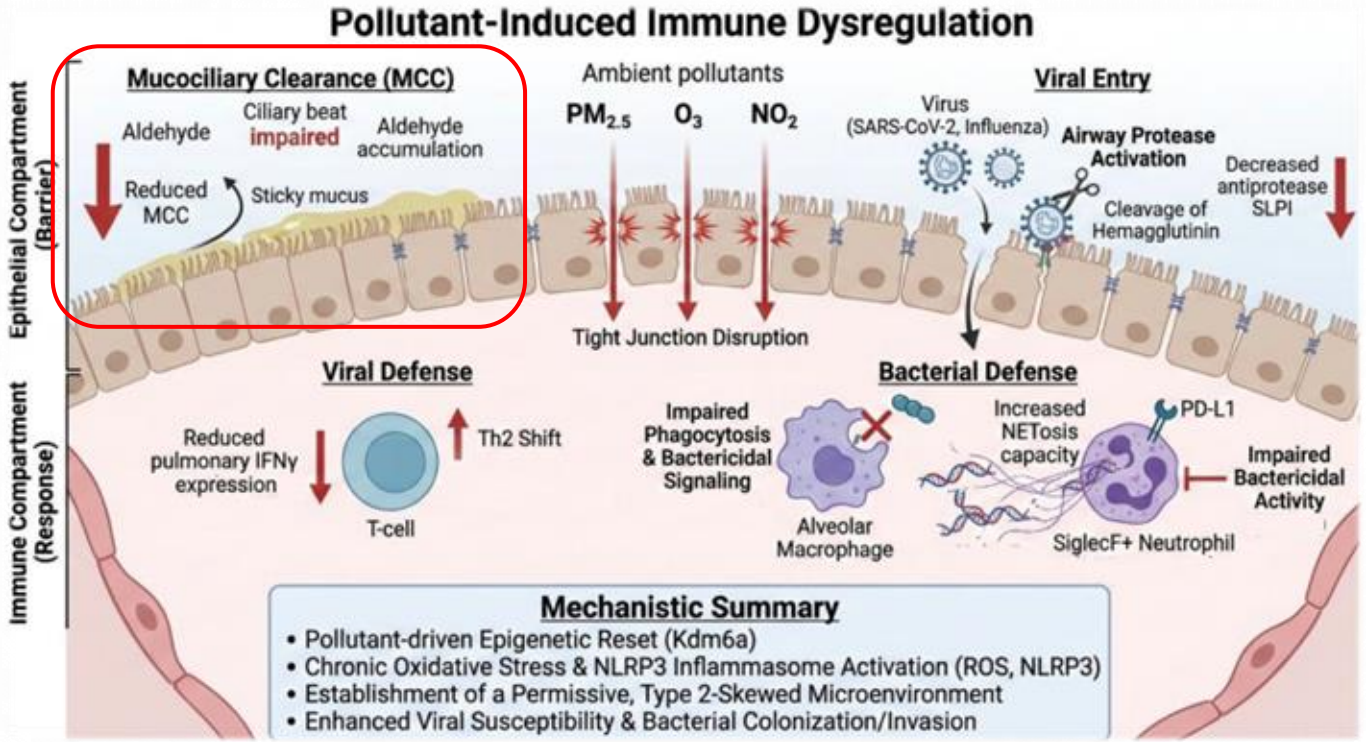
Dong, et al. Sci Adv. 2023.
Nature, 2023

Question de susceptibilité



Gaudet, et al. Intensive Care Med Exp. 2026

Question de susceptibilité



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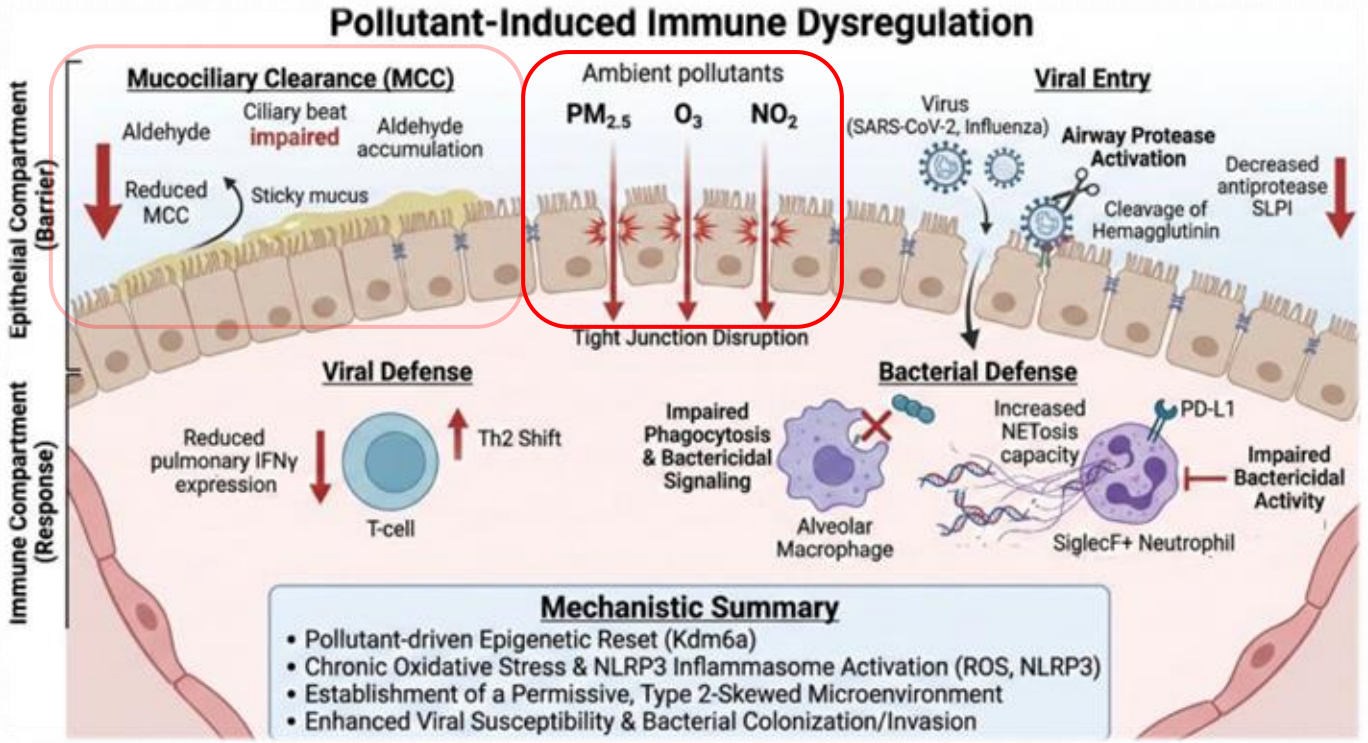
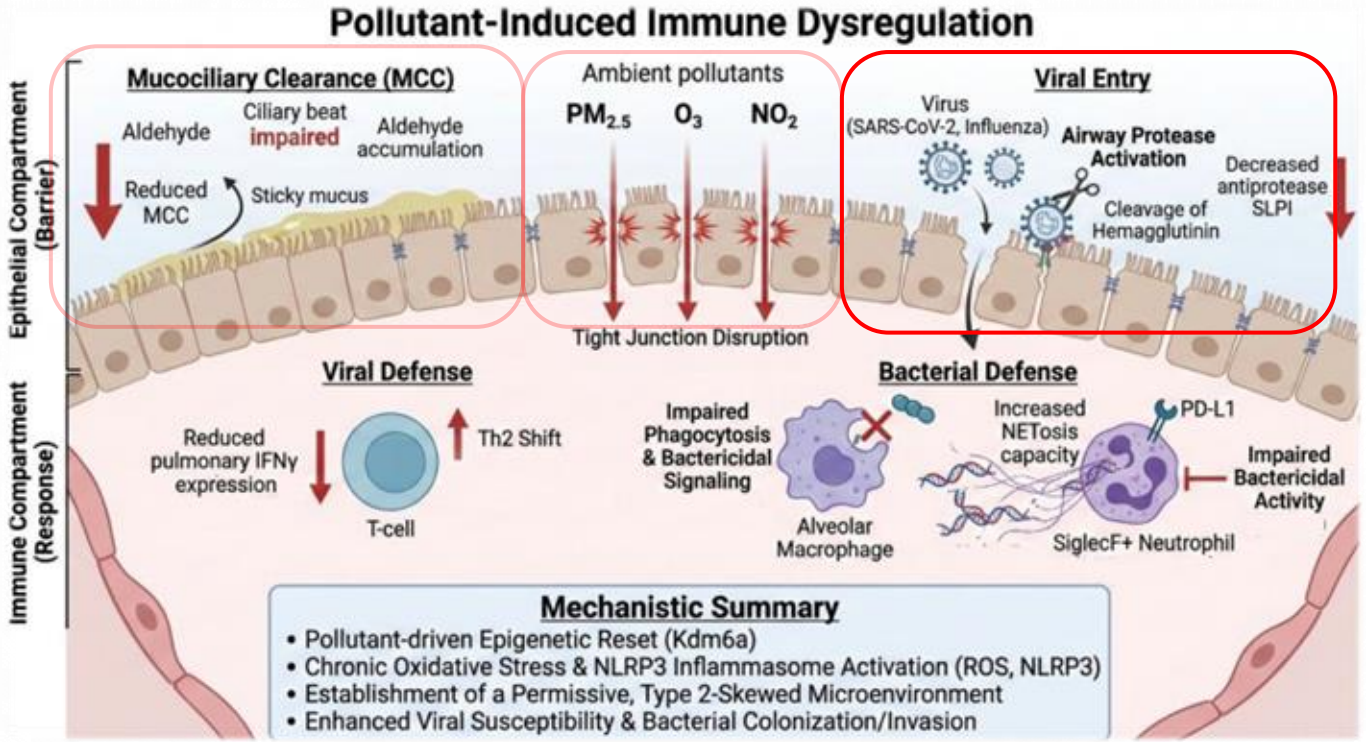


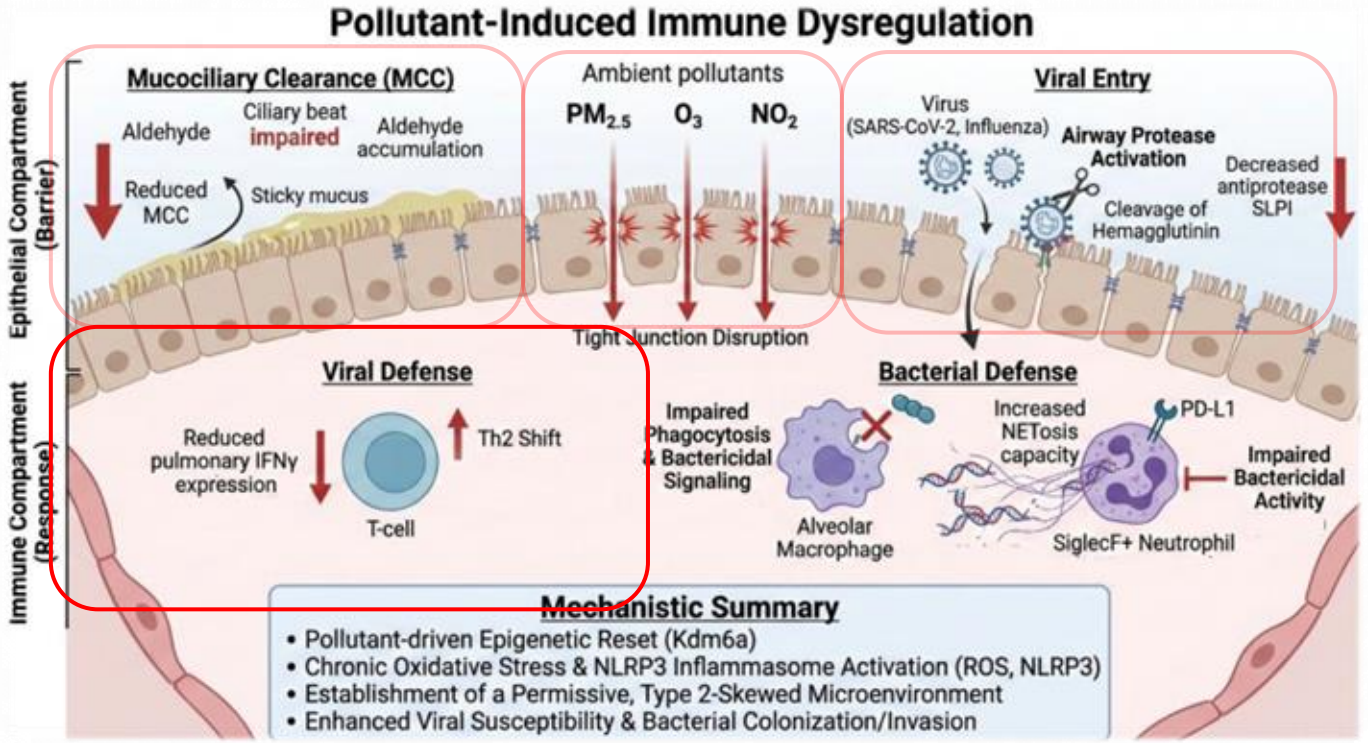
Gaudet, et al. Intensive Care Med Exp. 2026

Question de susceptibilité



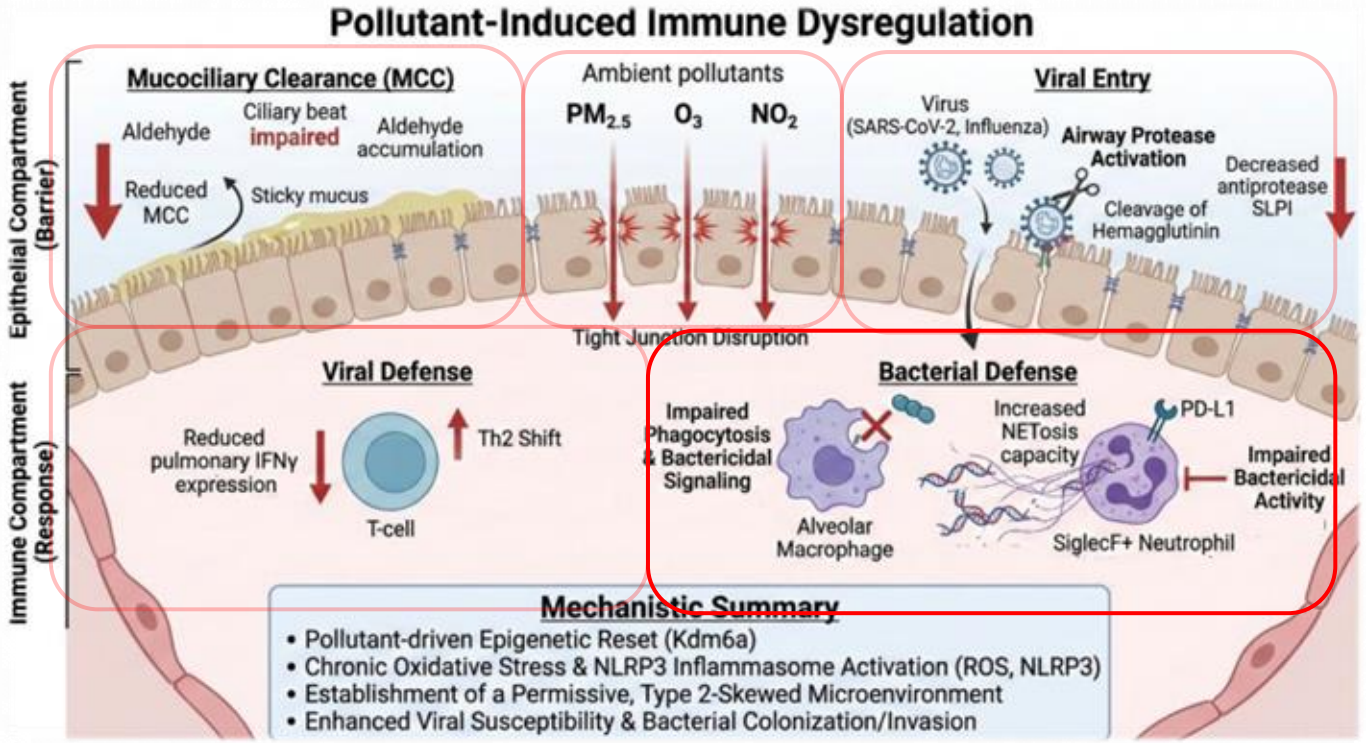
Gaudet, et al. Intensive Care Med Exp. 2026

Question de susceptibilité



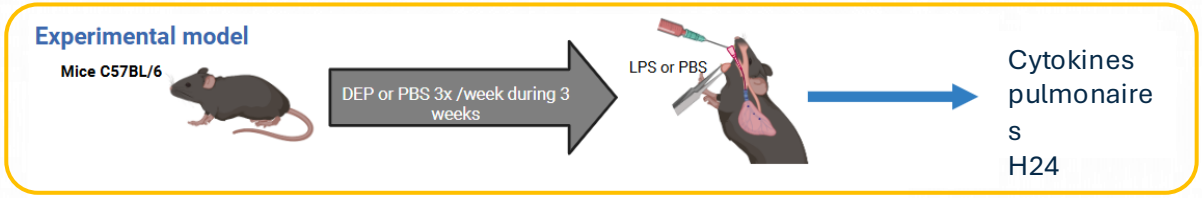
Gaudet, et al. Intensive Care Med Exp. 2026

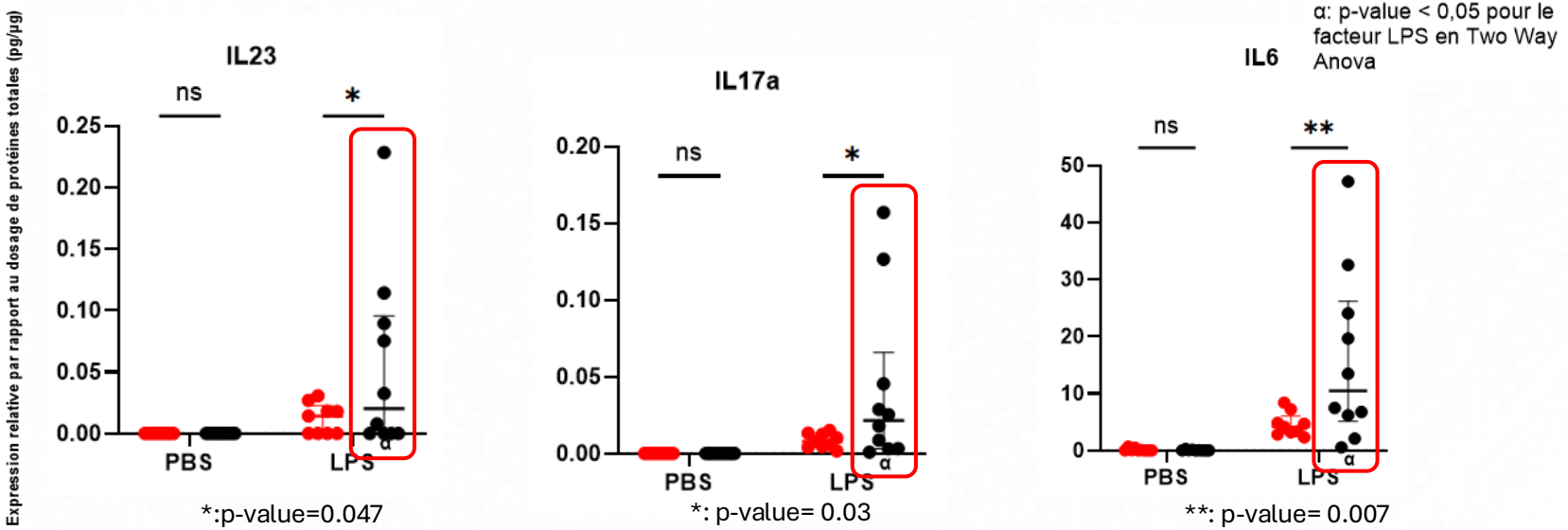
Question de susceptibilité…



Gaudet, et al. Intensive Care Med Exp. 2026

…et d'inflammation





*:p-value=0.047

*: p-value= 0.03

**: p-value= 0.007

Données U1019 – C. Lacombe / A. Gaudet

Quel impact épidémiologique ?
Pics de pollution

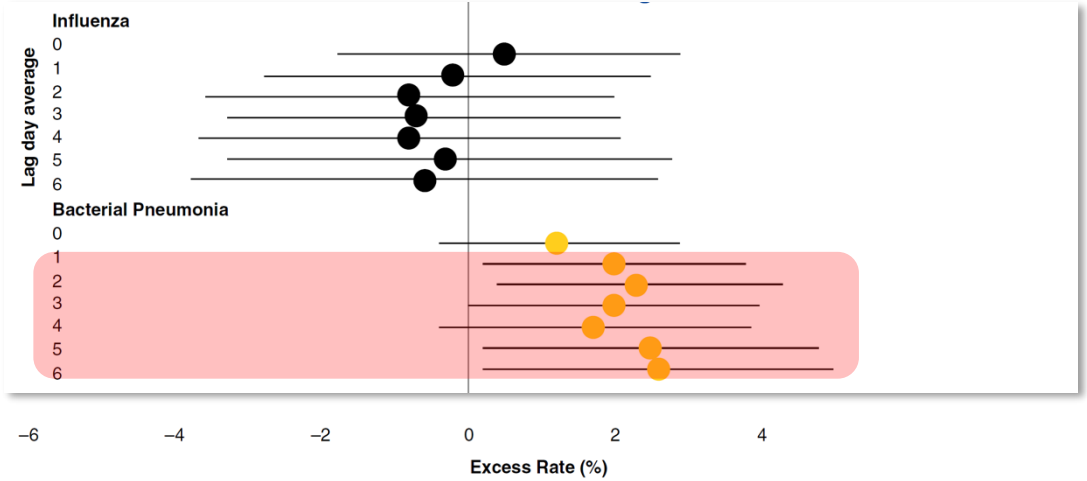
Pics de pollution – Un impact…

+5µg/m^3 $PM_{2.5}$

Etat de New York

Base de données SPARCS
500 000 d'évènements
2005 – 2016

Hospitalisations
Pneumonies



Croft, et al. Annals of ATS. 2019

Pics de pollution – Un impact…

Etat de New York

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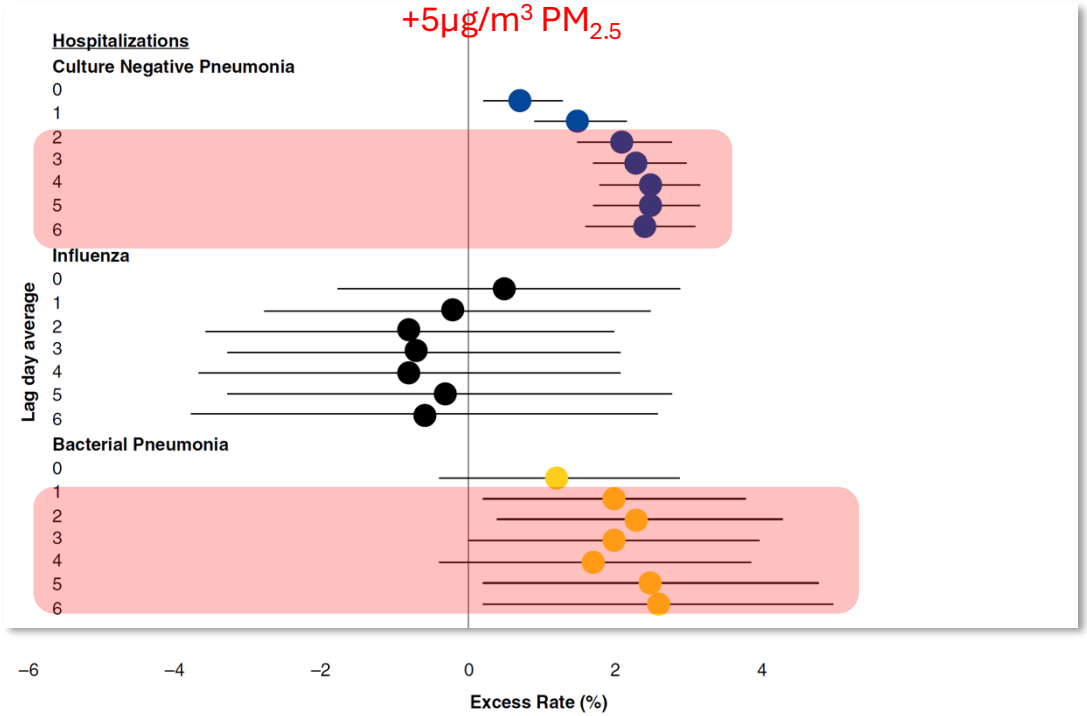

Croft, et al. Annals of ATS. 2019

Pics de pollution – Un impact…

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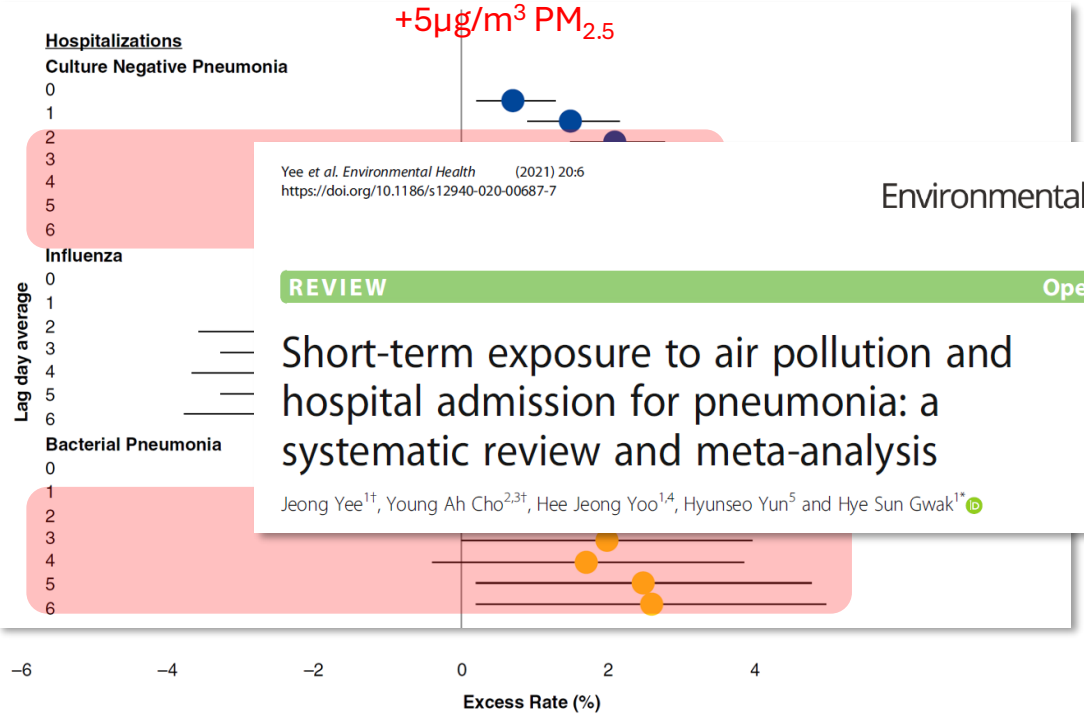


Yee et al. Environmental Health (2021) 20:6
https://doi.org/10.1186/s12940-020-00687-7

Environmental Health

REVIEW Open Access

Short-term exposure to air pollution and hospital admission for pneumonia: a systematic review and meta-analysis

Jeong Yee[1†], Young Ah Cho[2,3†], Hee Jeong Yoo[1,4], Hyunseo Yun[5] and Hye Sun Gwak[1*]

Check for updates

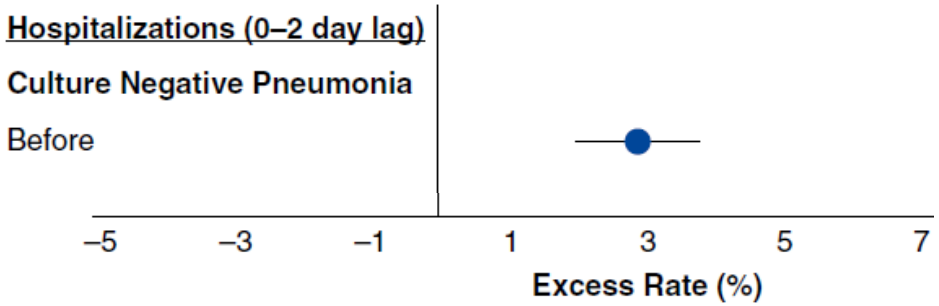
Croft, et al. Annals of ATS. 2019

Pics de pollution – Un impact… réversible ?

Etat de New York

Base de données SPARCS
500 000 d'évènements
2005 – 2016

Hospitalisations
Pneumonies



Croft, et al. Annals of ATS. 2019

Pics de pollution – Un impact… réversible ?

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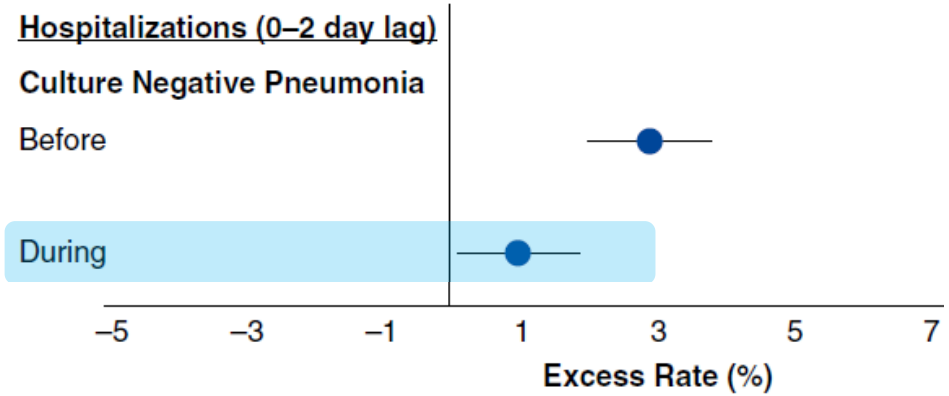
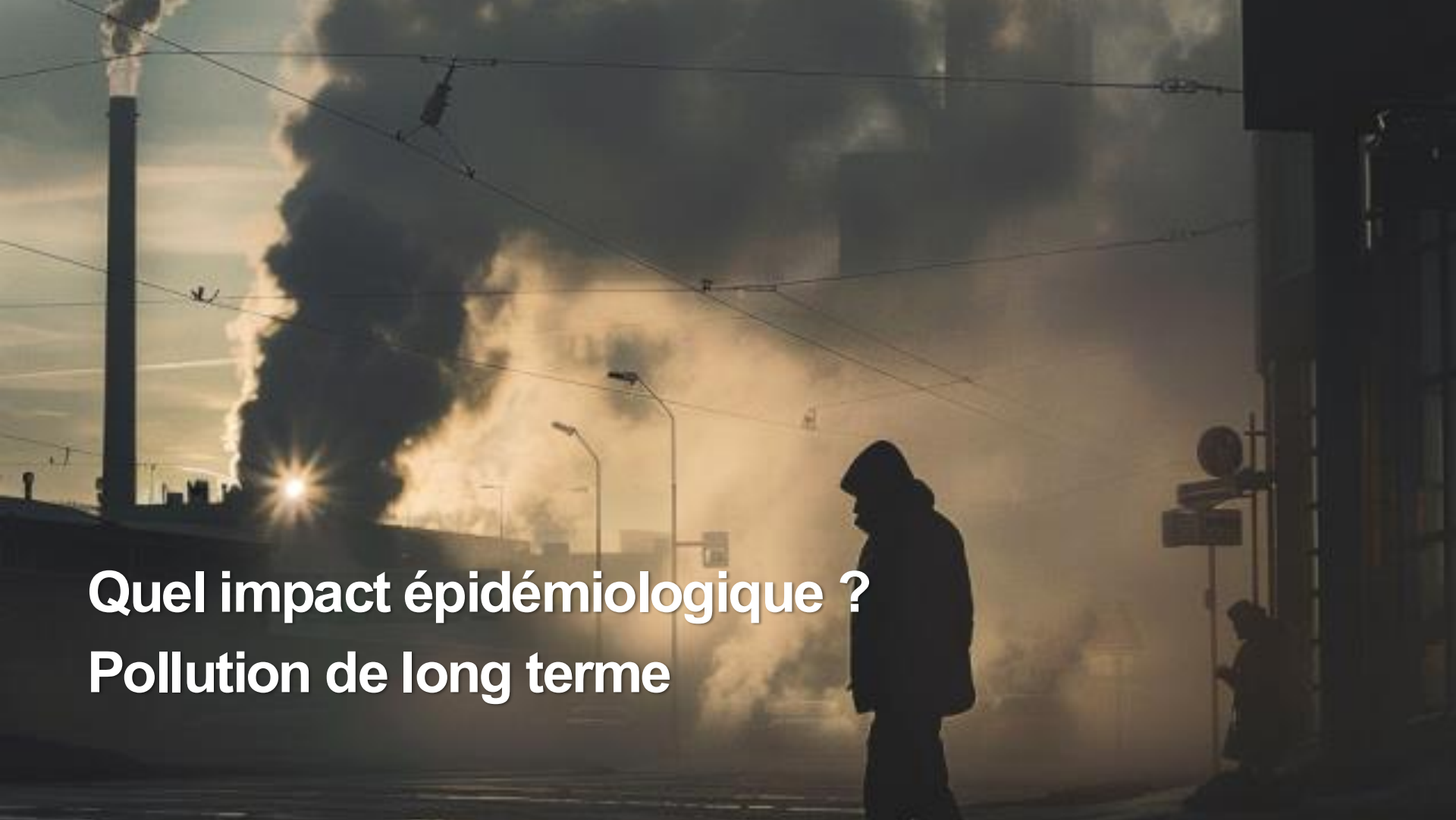
500 000 d'évènements
2005 – 2016

Hospitalisations
Pneumonies

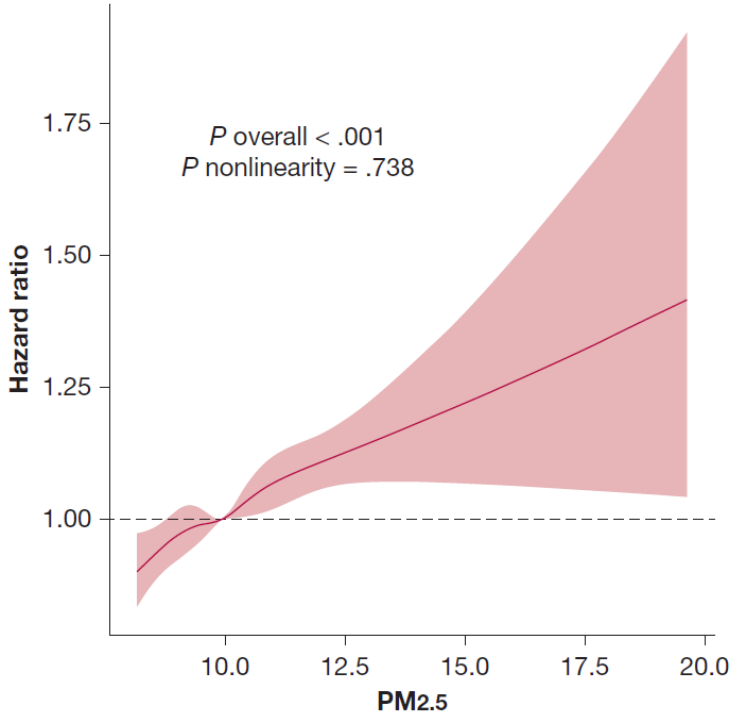


Croft, et al. Annals of ATS. 2019



Quel impact épidémiologique ?
Pollution de long terme

Pollution de fond et pneumonies…



UK
2006 – 2010

> 400 000 sujets

Hospitalisations
Pneumonies

Wang, et al. Chest. 2023.

Pollution de fond et pneumonies… et autre IRB ?

ELSEVIER

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

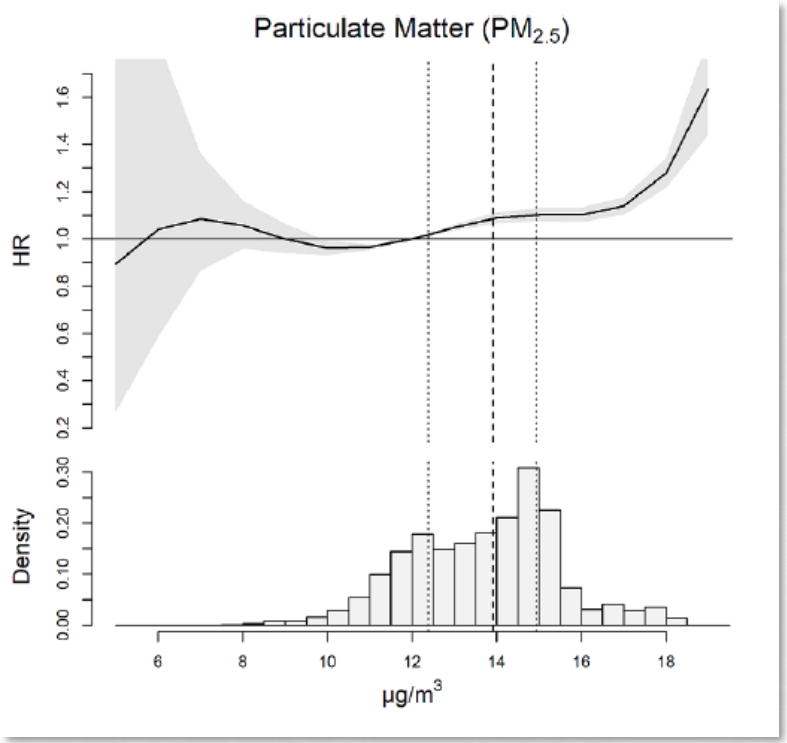
Full length article

Long-term exposure to air pollution and lower respiratory infections in a large population-based adult cohort in Catalonia

Anna Alari [a,b,c], Otavio Ranzani [a,b,c], Carles Milà [a,b], Sergio Olmos [a,b,c], Xavier Basagaña [a,b,c], Payam Dadvand [a,b,c], Talita Duarte-Salles [d,e], Mark Nieuwenhuijsen [a,b,c], Cathryn Tonne [a,b,c,*]

[a] Barcelona Institute for Global Health, ISGlobal, Barcelona, Spain
[b] Universitat Pompeu Fabra (UPF), Barcelona, Spain
[c] CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain
[d] Fundació Institut Universitari per a la recerca a l'Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol), Barcelona, Spain
[e] Department of Medical Informatics, Erasmus University Medical Center, Rotterdam, the Netherlands

Pollution de fond et pneumonies… et autre IRB ?



Catalogne
2015 – 2019

> 4 000 000 sujets

Hospitalisations
90 000 IRB
Dont 60 000 pneumonies

Alari, et al. Environ int. 2025.

Face à la pollution – Tous égaux ?

Smoking status	PM2.5	No of events	Crude incidence/per 100,000 person-year	HR (95% CI)
Never	Q1	1,714	251.24	Ref
	Q2	1,762	258.28	1.00 (0.93, 1.07)
	Q3	1,714	251.24	0.99 (0.93, 1.07)
	Q4	1,725	252.85	1.07 (0.99, 1.15)

UK
2006 – 2010

> 400 000 sujets

Hospitalisations
Pneumonies

Wang, et al. Chest. 2023.

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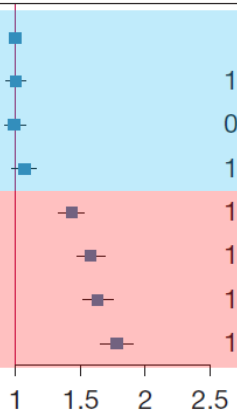
	Q2	2,645	516.76	1.58 (1.48, 1.68)
	Q3	2,798	539.07	1.63 (1.53, 1.74)
	Q4	3,251	575.73	1.78 (1.67, 1.90)



UK
2006 – 2010

> 400 000 sujets

Hospitalisations
Pneumonies

Wang, et al. Chest. 2023.

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Liu, et al. AJRCCM. 2022.

UK
2006 – 2010

> 400 000 sujets

Hospitalisations
Pneumonies

Wang, et al. Chest. 2023.

Face à la pollution – Tous égaux ?

e-Table 5. The associations between air pollution and pneumonia risk stratified by age, sex, body mass index, and income level

Subgroups	Total	Incidence (per 100000 person-year)	Crude		*P* for interaction	Adjusted		*P* for interaction
			HR (95% CI)	*P*		HR (95% CI)	*P*	
$PM_{2.5}$, per IQR increase	+1.28µg/m³ $PM_{2.5}$							
Age, years								
< 65	360281	290.31	1.13 (1.10, 1.15)	<0.001		1.01 (0.99, 1.04)	0.338	
≥ 65	85192	778.10	1.19 (1.15, 1.22)	<0.001	0.004	1.08 (1.05, 1.12)	<0.001	**<0.001**

Wang, et al. Chest. 2023.

Face à la pollution – Tous égaux ?

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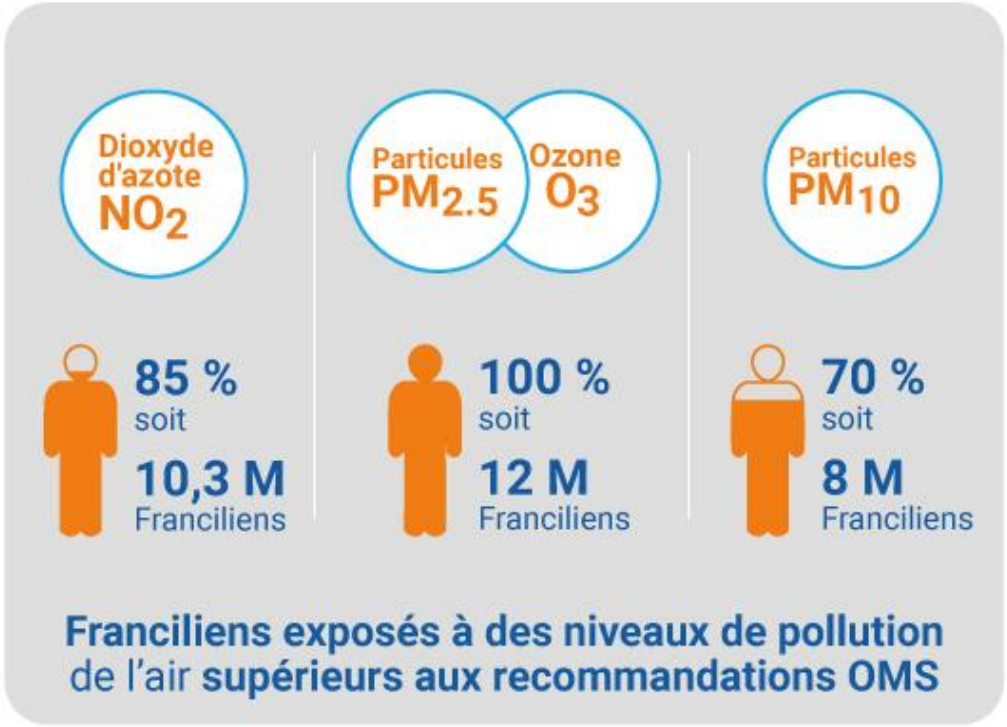
Wang, et al. Chest. 2023.


Tous concernés ?

Tous concernés ?
Pollution ambiante



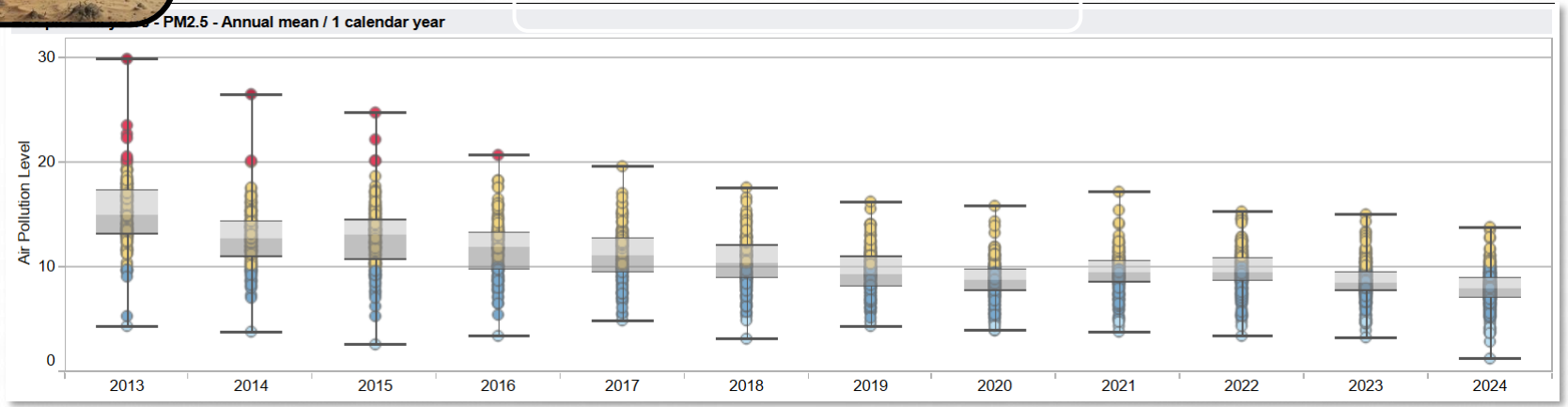
https://www.airparif.fr/surveiller-la-pollution/bilans-et-cartes-annuels-de-

Tous concernés ?
Pollution ambiante

https://www.airparif.fr/surveiller-la-pollution/bilans-et-cartes-annuels-de-

Tous concernés ?
Pollution ambiante

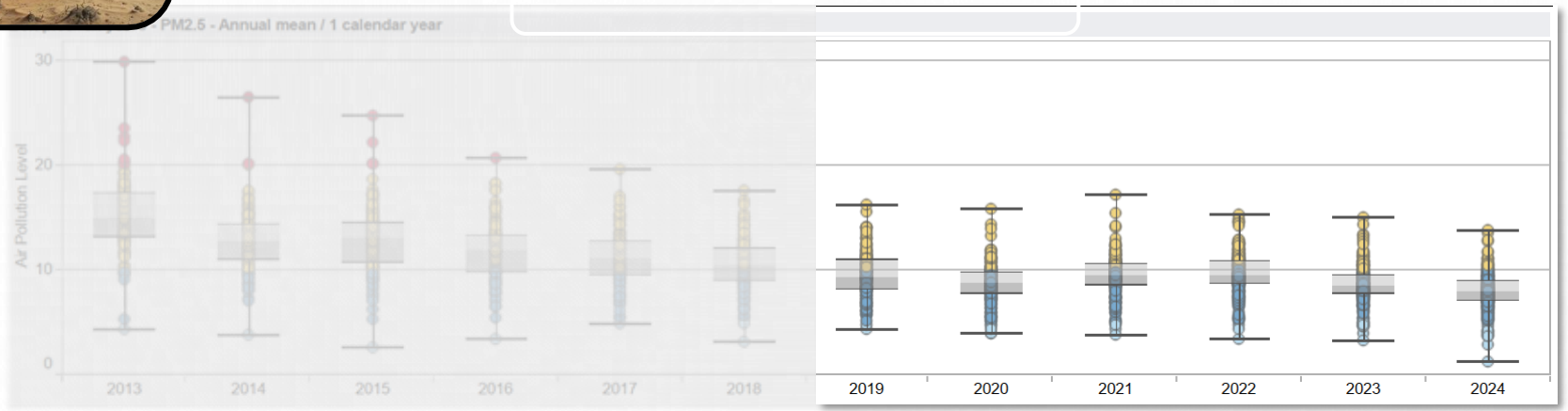
PM2.5 – Tendance de fond



https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pollution ambiante

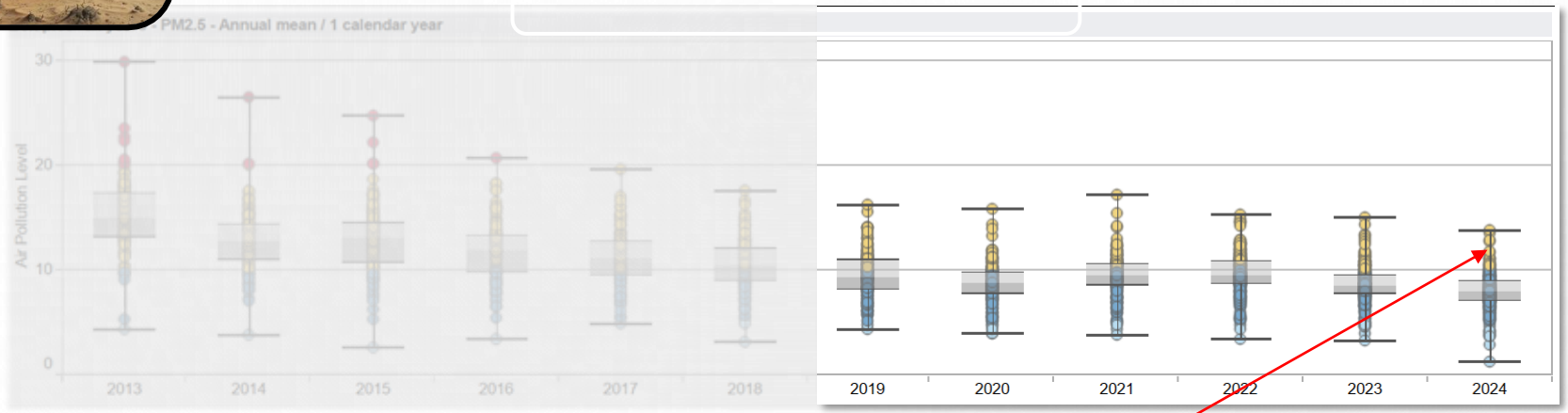
PM2.5 – Tendance de fond



https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pollution ambiante

PM2.5 – Tendance de fond



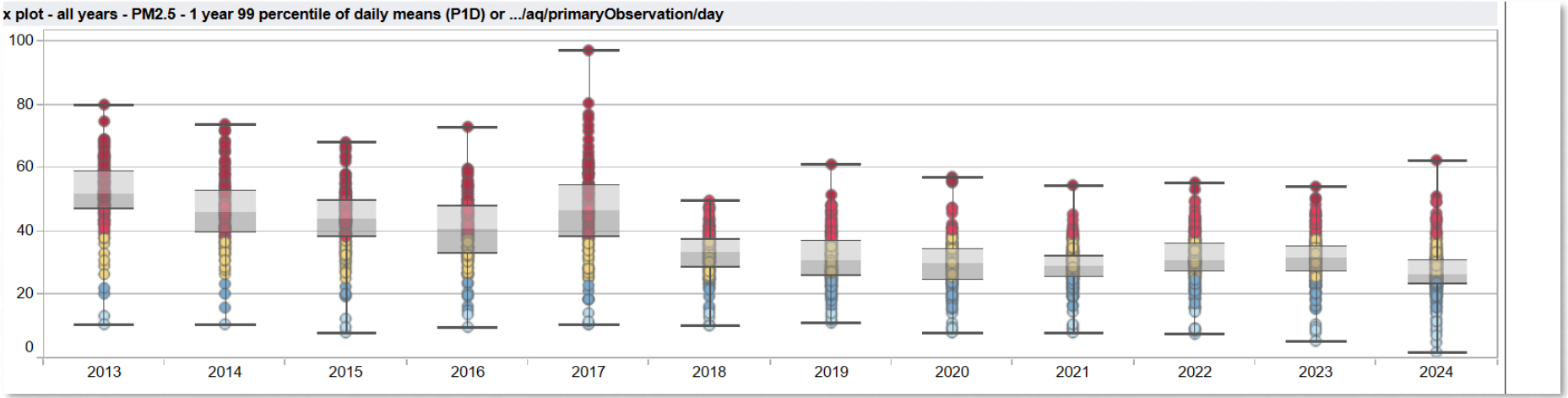
Year: **2024**
Country: **France**
City: **Paris (greater city)**
Station Name: **Auto A1 -Saint-Denis**
Sampling Point: **SPO-FR04058_6001**
Type: **Urban - Traffic**

PM2.5: Annual mean / 1 calendar year = 13,724 ug/m3

https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pics de pollution

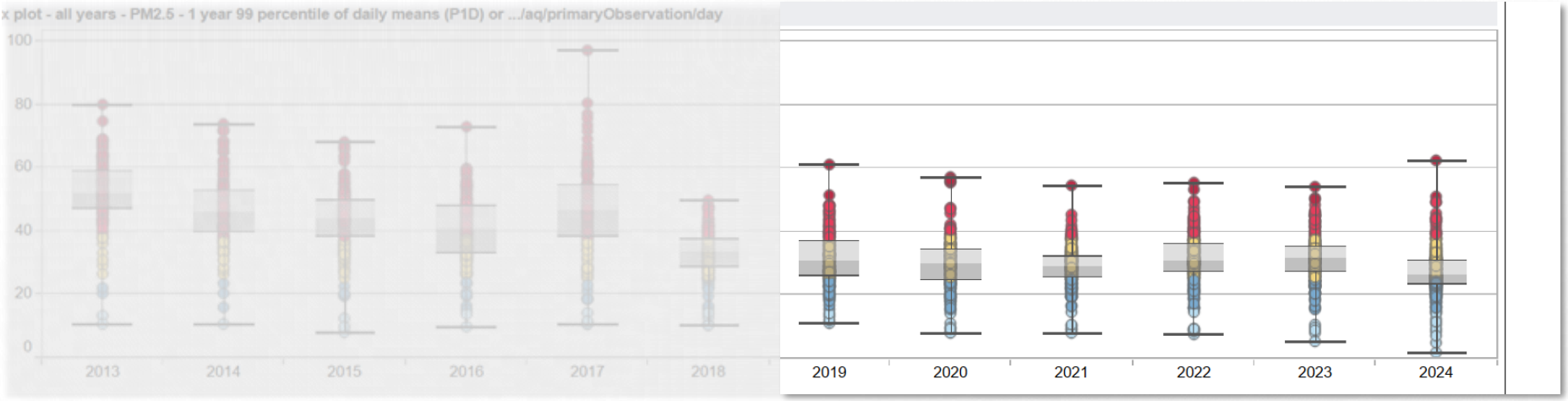
PM2.5 – Pics de pollution



https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pics de pollution

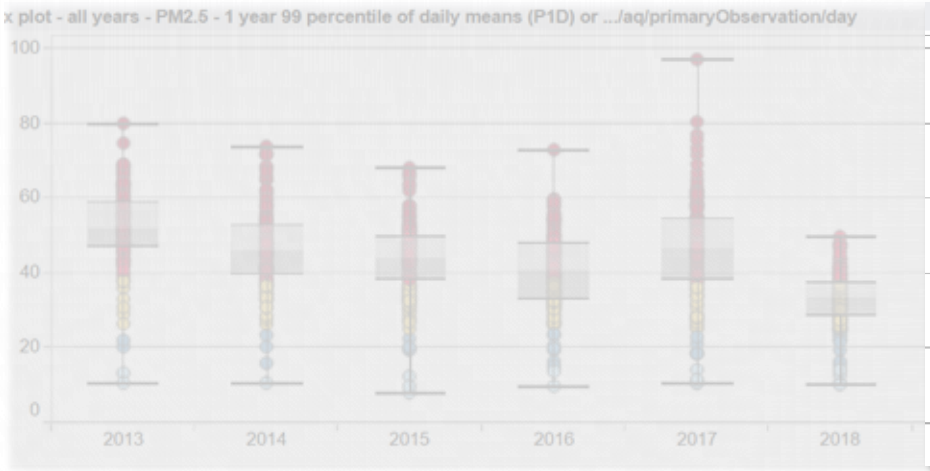
PM2.5 – Pics de pollution

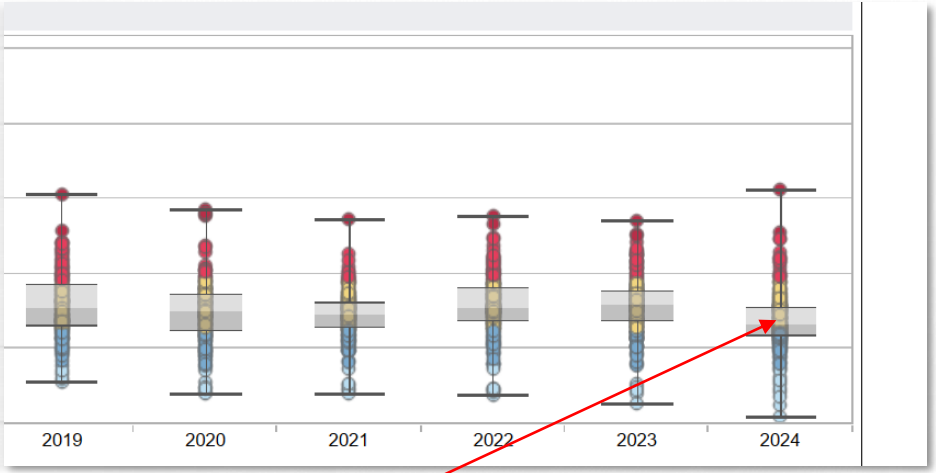


https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pics de pollution

PM2.5 – Pics de pollution



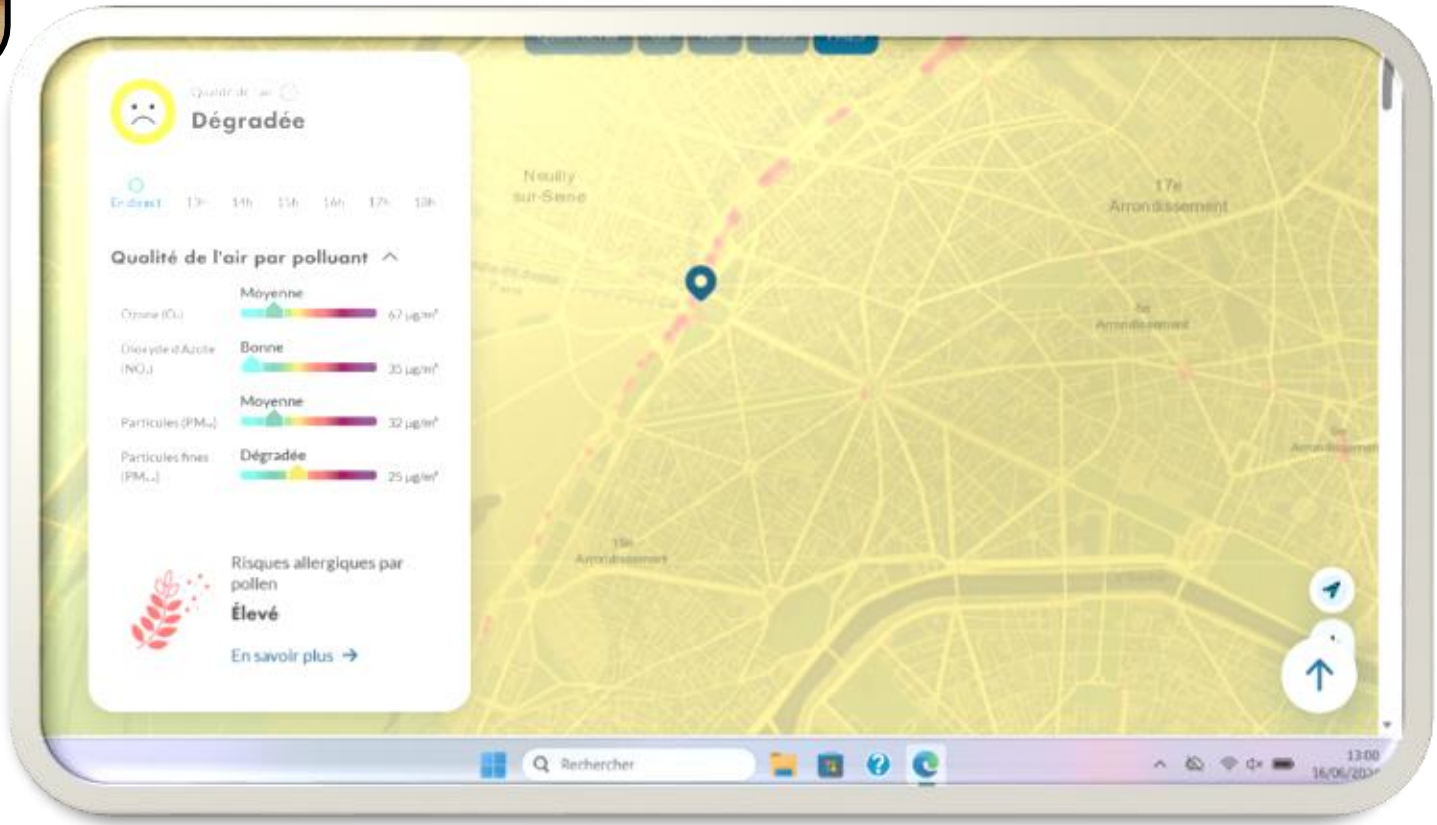


Year: **2024**
Country: **France**
City: **Paris (greater city)**
Station Name: **PARIS 1er Les Halles**
Sampling Point: **SPO-FR04055_6001**
Type: **Urban - Background**

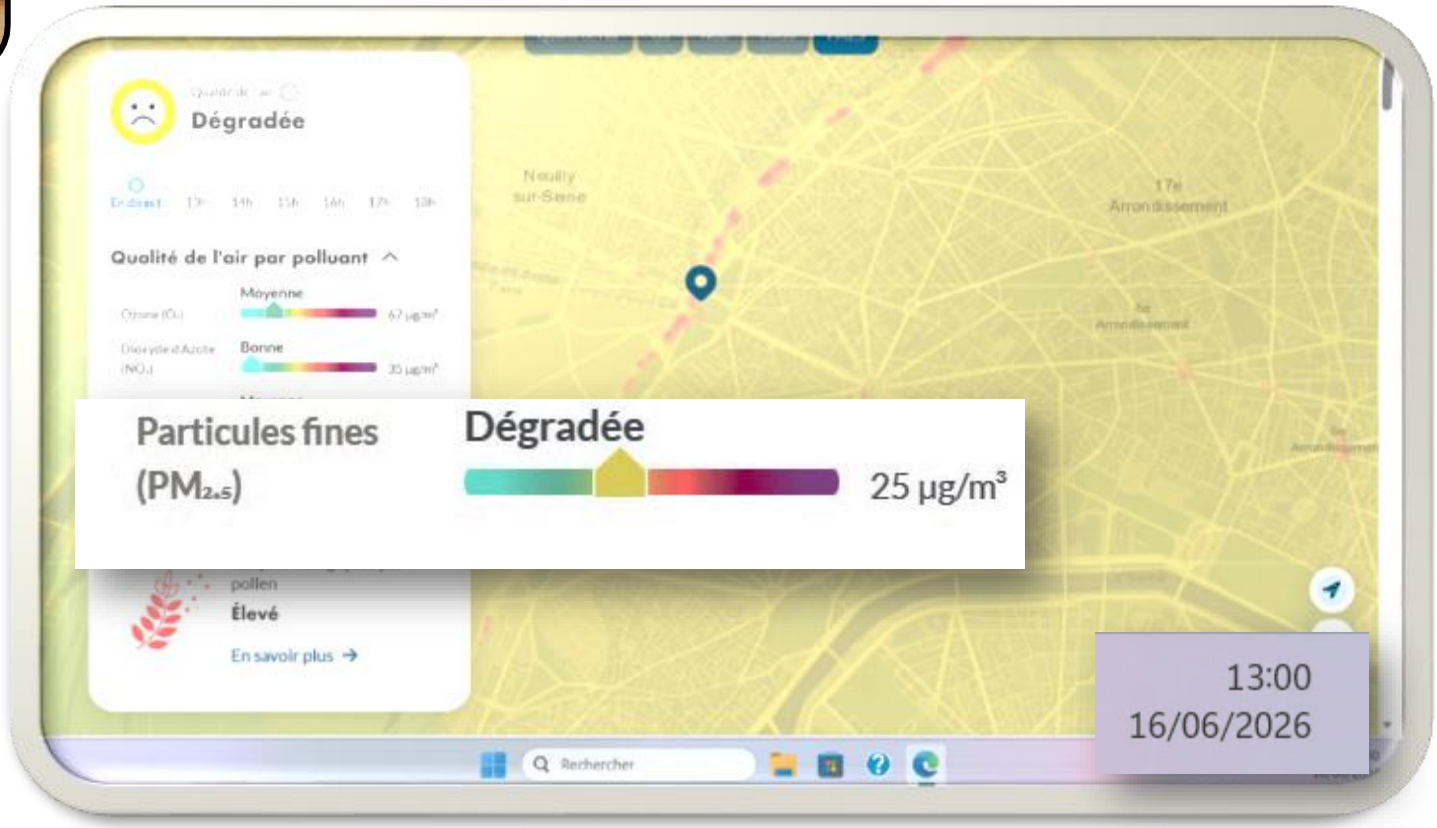
PM2.5: 1 year 99 percentile of daily means (P1D) or .../aq/primaryObservation/day = 25,84 ug/m3

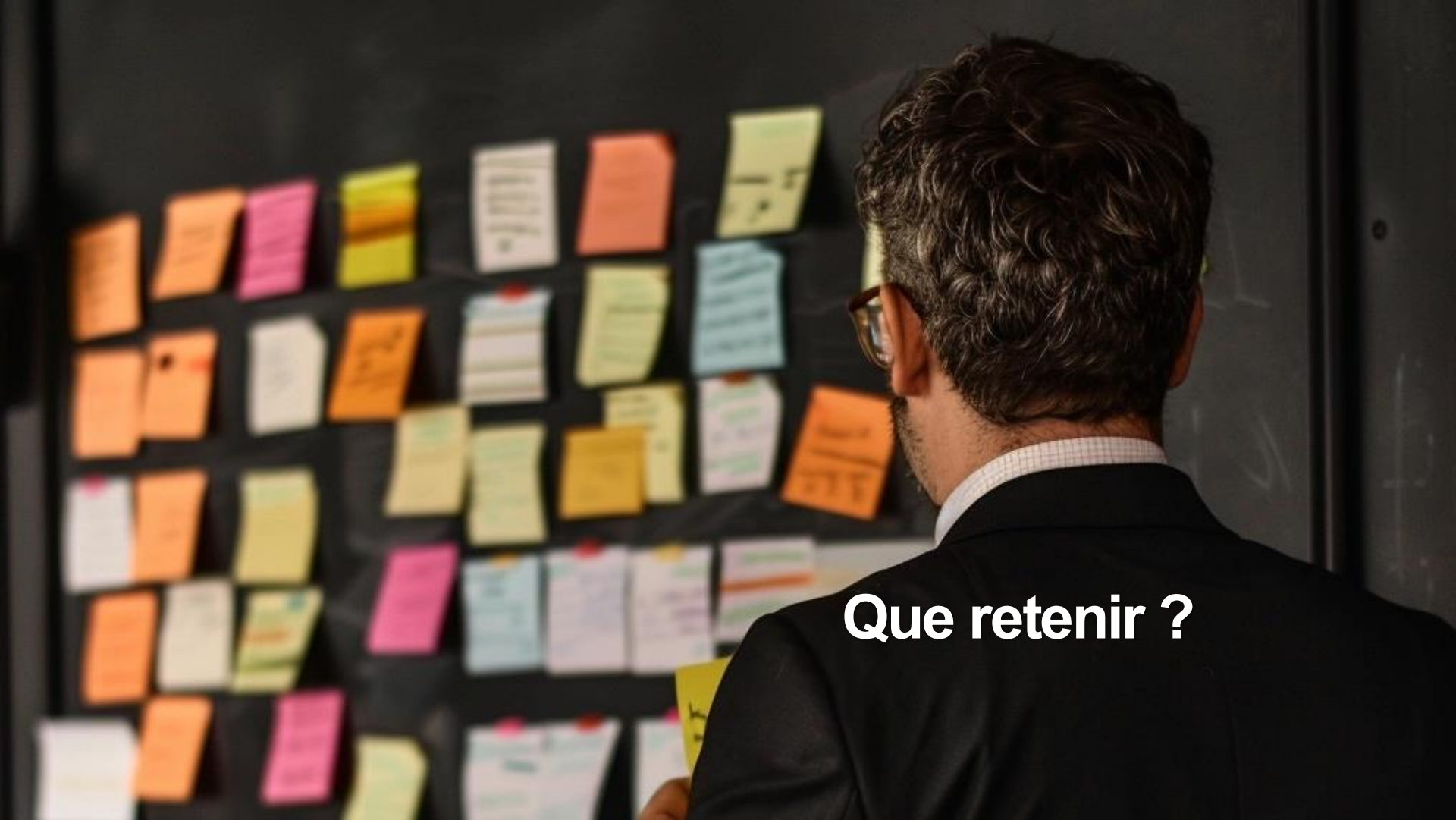
https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

Tous concernés ?
Pics de pollution



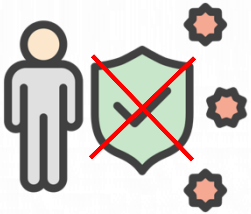
Tous concernés ?
Pics de pollution



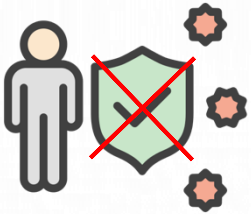

Que retenir ?

Take-home messages

Take-home messages

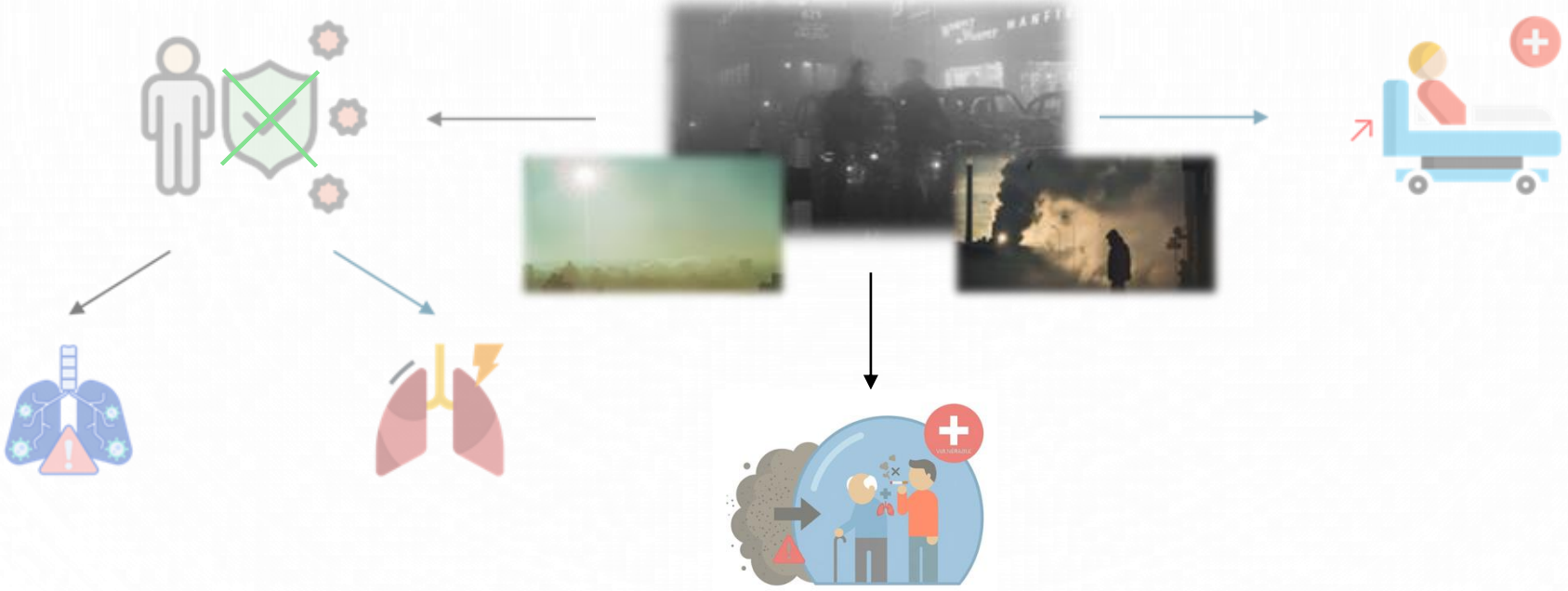


Take-home messages

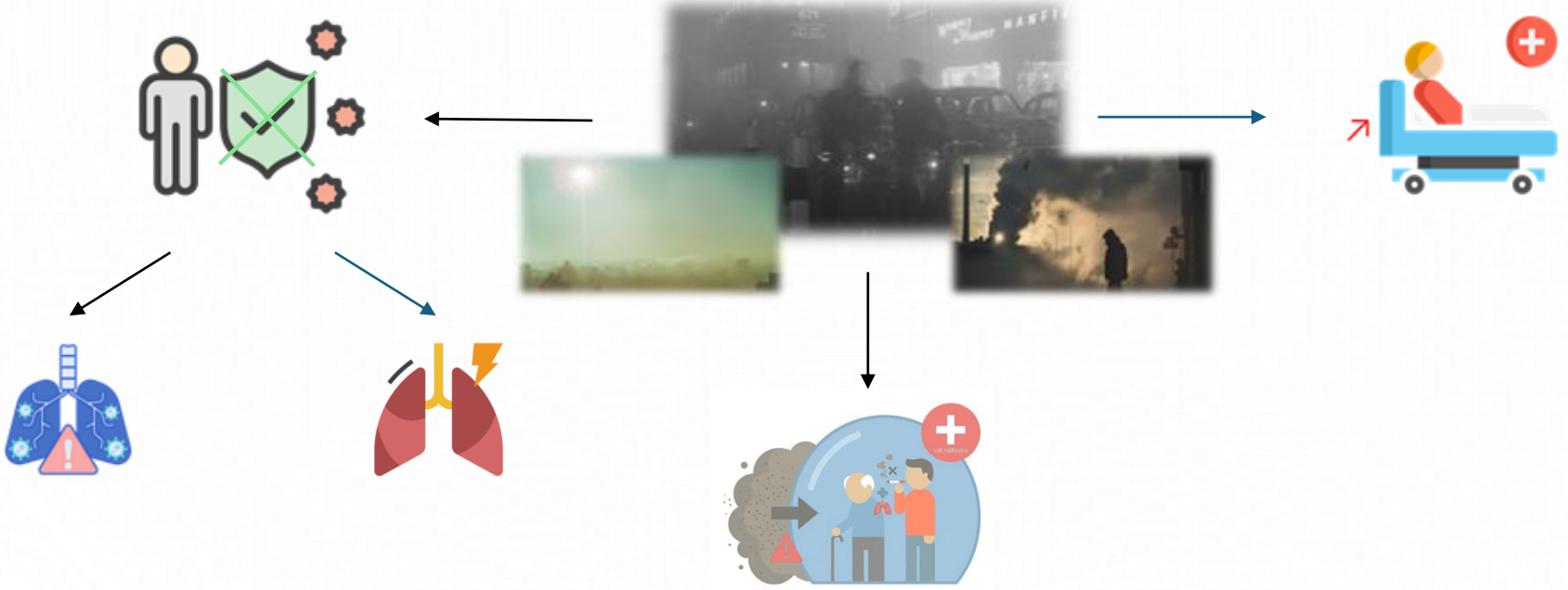


Take-home messages

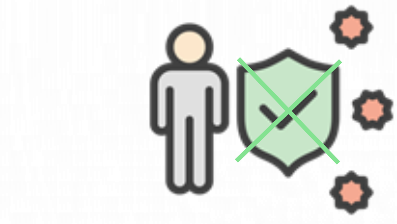
Take-home messages



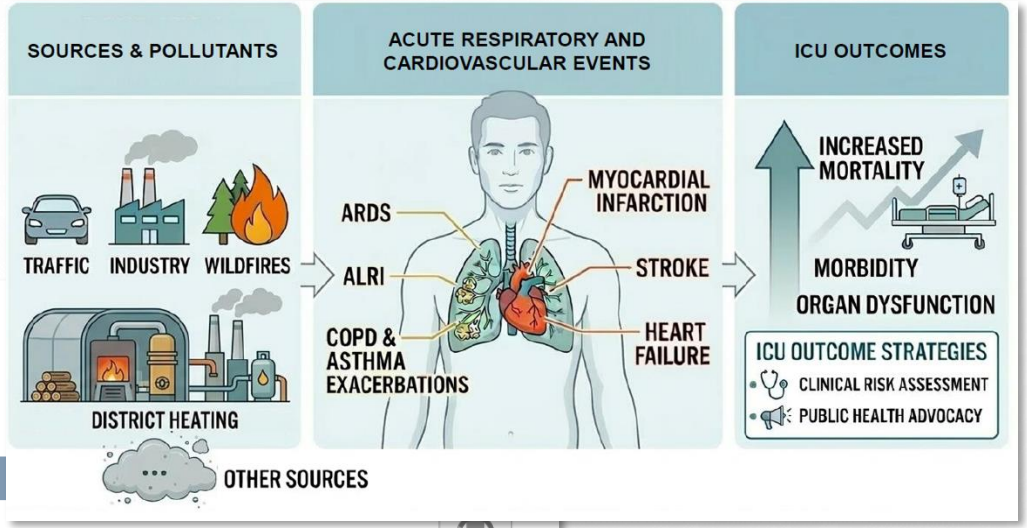
Take-home messages



Take-home messages



Pour aller (un peu) plus loin…



Gaudet *et al.*
Intensive Care Medicine Experimental (2026) 14:62
https://doi.org/10.1186/s40635-026-00908-2

REVIEWS

Impact of air pollution on exacerbations of respiratory and cardiovascular diseases for the intensivist: a narrative review

Alexandre Gaudet[1,2,3*], Charlotte Lacombe[1,2,3], Gaetan Piga[1,2,3], Patricia de Nadaï[2,3]Group for theAssessment of ICU-related Impacts of Air pollution (GAÏA)

GAÏA : P. Aigrain – C. Baron – L. Dauchet – P. de Nadaï – J. Dumontet – L. Engels – C. Lacombe – M. Martin – C. Mille – M. Pascual – G. Piga Illustrations : Midjourney - Flaticon